

U.S. 40 Carbon Neutral Corridor Final Appendices

prepared for

Maryland Department of Transportation

U.S. 40 CNC Interagency Steering Committee

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A. Interagency Steering Committee

US 40 Carbon Neutral Corridor – Interagency Steering Committee

Agency	Name
Maryland Department of Transportation (MDOT)	Don Halligan, Michelle Martin, Stacey Dahlstrom, Marty Baker, Meg Andrews, Kate Sylvester, Howard Simons, Dorothy Morrison, Debbie Bowden
Maryland Transportation Authority (MDTA)	Dennis Simpson, Matthew Teitt
Maryland Transit Administration (MTA)	Pat Keller, Gerald Cichy
State Highway Administration (SHA)	Greg Slater, Elizabeth Habic, Dami Kehinde
Baltimore County	Jackie MacMillan
Harford County	Erin Ferriter, Pete Gutwald, Tony McClune
Maryland Energy Administration (MEA)	Chris Rice
Maryland Department of Business and Economic Development (DBED)	Robert Sklar
UMD National Center for Smart Growth	Fred Ducca
Maryland Department of General Services (DGS)	Christopher Falkenhagen
Maryland Department of the Environment (MDE)	Luke Wisniewski
Maryland Department of Housing and Community Development (DHCD)	Caroline Varney-Alvardo, John Papagni
Maryland State Department of Education (MSDE)	David Lever
Maryland Department of Natural Resources (DNR)	David Goshorn
Maryland Department of Planning (MDP)	Peter Conrad, Stephanie Martins
Maryland Department of Agriculture (MDA)	Deb Vaughn



B. Initial Corridor Screening Results

Corridor Initial Screening Summary

1. MD 355 – Bethesda to MD 124/Gaithersburg – 14 miles:

Pros: Modal and land use mix, located in Priority Funding Areas (PFAs), potential partnership opportunities with National Institute of Health and Dept. of Defense (National Naval Medical Center), high level of community interest

Cons: Existing/built out development, minimal conservation opportunities, multiple municipalities and diverse stakeholder groups, low level of corridor strategy transferability, high level of coordination required with multiple state and local planning activities ongoing

Result: Not carried forward as a pilot corridor.

2. I-795/MD 140 – Proposed Limits (I-695 to Westminster – 21 miles):

Pros: Modal mix, located in Priority Funding Areas (PFAs), extensive conservation/restoration opportunities in Carroll County, Owings Mills TOD

Cons: Existing/built out development, marginal opportunities for conservation in Baltimore County portion, influence of I-695 traffic and congestion

Result: **Selected for detailed review.** Two extents of the corridor will be studied: Section I: I-795 from I-695 to Reisterstown, and Section II: I-795/MD 140 from I-695 to Westminster.

3. I-83 – Proposed Limits (I-695 to MD 137 – 13 miles):

Pros: Modal mix, majority of the section in Priority Funding Areas (PFAs), corridor buffer area has conservation land and reservoirs, opportunities for agricultural land preservation.

Cons: Interstate through traffic (passenger and freight), growth in PA (outside of our control)

Result: **Selected for detailed review.** Corridor limits should extend beyond Shawan Road and could extend to the PA State line to incorporate maximum opportunities for conservation area offsets.

4. US 1 – Proposed Limits (I-495 to I-195 – 23 miles):

Pros: Parallel to MARC Camden line, majority of the section in Priority Funding Areas (PFAs), corridor buffer area has conservation land, high growth corridor with opportunities for transferability.



Cons: Relatively high freight activity due to surrounding freight intensive land use in the corridor vicinity. High number of jurisdiction/ municipalities.

Result: Selected for detailed review.

5. US 40 – Proposed Limits (I-695 to MD 22/Aberdeen – 25 miles):

Pros: Bikeway corridor, freight corridor, predominantly within PFAs, conservation opportunities adjacent to Bay, Baltimore County Master Planning effort is a good supporting tool that will be useful in this effort. BRAC planning and implementation efforts at Aberdeen Proving Ground and Testing Center (collaboration opportunities).

Cons: Influence of I-95

Result: Selected for detailed review.

6. I-270 – Proposed Limits (I-495 to I-70/Frederick – 36 miles):

Pros: Modal mix – existing and proposed, connects multiple Priority Funding Areas (PFAs)

Cons: Extent of the corridor, high travel volumes, manageability (multiple jurisdictions/municipalities, other studies ongoing/proposed)

Result: Not carried forward as a pilot corridor.

7. MD 175 – Proposed Limits (US 29 to MD 170 – 17 miles):

Pros: Modal mix – existing, majority of the section in Priority Funding Areas (PFAs), opportunity for conservation opportunities (US Fish and Wildlife Refuge) and planned growth. Inclusion of Ft. Meade (collaboration opportunities); SHA just completed a study of MD 175.

Cons: Multiple jurisdictions involved, crosses multiple high volume corridors

Result: Selected for detailed review.

8. US 50 – Proposed Limits (I-95/ I-495 to MD 404 – 48 miles) :

Pros: Connects Priority Funding Areas (PFAs), conservation opportunities

Cons: Modal mix (MTA commuter buses), travel patterns are different from other corridors considered which will affect transferability (high share of non-work related trips), multiple jurisdictions, length, manageability

Result: Not carried forward as a pilot corridor.

9. MD 185 - Proposed Limits (MD 97 to MD/DC Line – 9 miles) :

Pros: Modal mix, located in Priority Funding Areas (PFAs)

Cons: Existing/built out development, low level of corridor strategy transferability, marginal opportunities for conservation

Result: Not carried forward as a pilot corridor.



10. MD 30 – Proposed Limits (State Line to I-795/Reisterstown – 18 miles) :

Pros: Priority Funding Areas (PFAs) at south end of corridor, extensive agricultural/natural resource lands, manageability

Cons: Minimal modal mix, mostly exurban/rural development, growth plans uncertain

Result: Not carried forward as a pilot corridor.

11. MD 32 - Proposed Limits (MD 108 to MD 170 - 17 miles) :

Pros: Modal mix – existing and planned, connects Priority Funding Areas (PFAs)

Cons: Existing capacity constraints, safety aspects of MD 32 need to be considered before considering environmental aspects. MD 32 runs parallel to MD 175 and the buffer area covered by MD 175 covers the extent of MD 32 corridor.

Result: Not carried forward as a pilot corridor. MD 32 corridor will be considered as part of MD 175 corridor 5 mile study area.

12. MD 5 – Proposed Limits (I-95/I-495 to White Plains – 15 miles):

Pros: Modal mix – existing and planned, connects Priority Funding Areas (PFAs), high suburban growth area

Cons: Maintenance of pedestrian infrastructure is a major source of contention for selection of projects in Prince George’s County. Low conservation opportunities. Multiple studies recently completed or underway in corridor with varying objectives.

Result: Not carried forward as a pilot corridor.

13. I-70 – Proposed Limits (Frederick to I-695 – 36 miles):

Pros: Conservation opportunities, connection to Frederick PFA

Cons: Study manageability (4 counties), minimal modal mix, high interstate freight traffic

Result: Not carried forward as a pilot corridor.



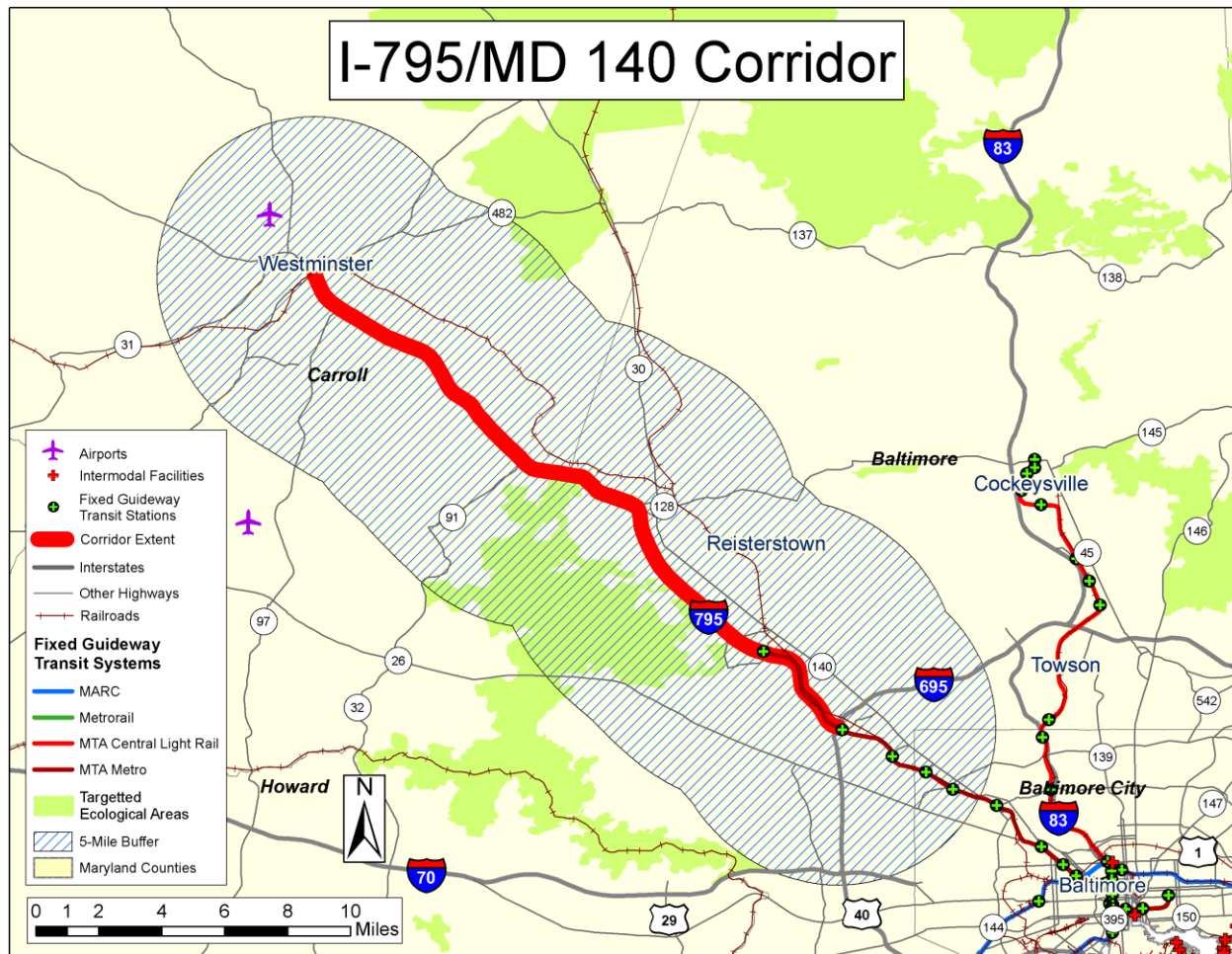
Table B.1 Carbon Neutral Corridor Initial Screening Results

Criteria Screening Mechanism			MD 355	I-795/ MD 140	I-83	US 1	US 40	I-270	MD 175	US 50	MD 185	MD 30	MD 32	MD 5	I-70
Modal Mix	Modal mix	0 - No transit service (existing/planned)													
		1 - Transit service limited to bus only (existing/planned)													
		2 - Fixed-guideway and bus service (existing/planned)													
Land Use & Development	Land use mix, intensity of growth Mix and complexity of natural environment	0 - Corridor with limited PFAs													
		1 - Corridor with PFAs and planned future growth													
		Level of forest and agricultural land within the corridor per green infrastructure map (0:< 15%, 1:>15% corridor area)													
Manageability	Ability to define logical geographic/ political boundaries	Number of governmental units in the corridor (0: >= 5, 1: < 5)													
	Supporting data	Availability of travel, land use and natural systems data													
Transferability	Transferability of strategies to other areas and corridors	0 - Not consistent with other growth areas													
		1 - Partly consistent with other growth areas													
		2 - Consistent with other growth areas													
Initial Corridor Screening Total			5	7	6	6	6	5	7	2	5	4	7	6	5



C. Final Corridor Screening Results

I-795/MD 140 CORRIDOR



The 21 mile I-795/MD 140 corridor area represented by a 5 mile buffer around the corridor includes I-695 and covers most of the area northwest of Baltimore City through Baltimore and Carroll Counties. An alternative corridor definition shortens the corridor length to the end of I-795 at the interchange with MD 140.

I-795 is the initial, high capacity, limited access link between Baltimore to Reisterstown, Westminister and longer distance travel to and from Hanover, PA. MD 140 starts in Downtown Baltimore and runs parallel to I-795 from I-695 to Reisterstown where the corridors merge. MD 140 acts as the continuation of I-795 and connects Westminister and eventually links to US 15 in Frederick County. The Baltimore METRO line starts in the corridor with a major park



and ride station at Owings Mills, and runs in the median of I-795 to Old Court Road, just inside I-695.

Opportunity – The I-795 corridor represents a high potential for GHG reduction in terms of mode shift from commute SOV trips resulting from improved transit service and expansion of TDM programs, particularly commuter based programs. Jobs housing balance within the corridor is expected to improve, particularly with significant plans for employment growth near Owings Mills. Overall projected population and employment growth in the corridor is less than the regional average; however, a high share of growth in Baltimore County is forecast to occur in PFAs, improving opportunities for higher densities, mixed use and non-motorized travel. Per Carroll County’s master plan and Agricultural Land Preservation Program, growth in the county is focused in the Westminster PFA and Finksburg.

The high share of undeveloped land in Carroll County and protected lands and reservoirs in Baltimore County leads to high opportunities for carbon sequestration activities from agricultural and other undeveloped lands. Also, a parallel freight rail corridor allows consideration of strategies that move truck freight to rail, a less carbon intensive mode.

Need – With continued growth in Carroll County and significant growth proposed near Owings Mills, traffic volumes and congestion will continue to increase on I-795 and MD 140. Already operating at LOS E or worse in the peak periods/peak direction for most segments of the corridor, congestion will spread and impact parallel and intersecting facilities in the future. Minimizing congestion impacts will require level of service improvements on transit and commuting options, and selective capacity expansions and ITS deployments to reduce congestion at corridor bottlenecks. Current mismatch of housing and employment opportunities in the corridor lead to longer commutes and a higher level of dependence for most commuters in driving to work. Expanded ridesharing and commute incentives programs are needed.

Feasibility – The potential level and cost of transportation investment in this corridor is high, particularly if it includes new interchanges on I-795 or expansion of MD 140. Recent planning and public outreach in the I-795 corridor has brought stakeholders together to discuss the impacts and potential solutions with regard to growth near Owings Mills. The feasibility of attaining significant emission offsets in the corridor is high given the progressive nature of Baltimore County’s rural area planning and Carroll County’s agriculture preservation planning.

Complexity – I-795 is characterized by a distinct commute travel market, with a major parallel commercial corridor (MD 140) serving local trips. MD 140 north of I-795 is also predominantly a commute corridor, however it mixes with local traffic accessing residential and commercial development. There are only four jurisdictions to consider. Planned suburban growth in Carroll County may create issues with regard to eliminating some offset opportunities. The presence of I-695 within the corridor presents the most complex issues as the corridor is highly congested with passenger and freight vehicles, it distributes vehicle travel throughout the Baltimore region and also serves as a bypass of Baltimore. These trips require a completely different set of strategies than what is needed to address transportation issues on I-795.

I-83 CORRIDOR



The 13 mile I-83 corridor area represented by a 5 mile buffer around the corridor includes I-695, covers most of the area north of Baltimore City. I-83 is the primary facility linking Baltimore to York and Harrisburg in central Pennsylvania. The corridor is 4 lanes from the PA state line to Shawan Rd. where it transitions to 6 lanes. Parallel to I-83 is MD 45 which serves as the primary commercial corridor linking the town centers of Hunt Valley, Cockeysville, Timonium, Lutherville and Towson. Major roads crossing the corridor are MD 138/137, MD 145/Shawan Rd and I-695.

Opportunity – The I-83 corridor represents a high potential for GHG reduction in terms of mode shift from commute SOV trips resulting from improved transit service and expansion of TDM programs, particularly commuter based programs. Jobs housing balance within the corridor reflects high opportunity for living close to where you work as long as the majority of growth continues within PFAs. Overall projected population and employment growth in the corridor is the slowest of all the corridors evaluated and likely will continue to lag regional growth as long as Baltimore County maintains its urban growth boundary and rural zoning



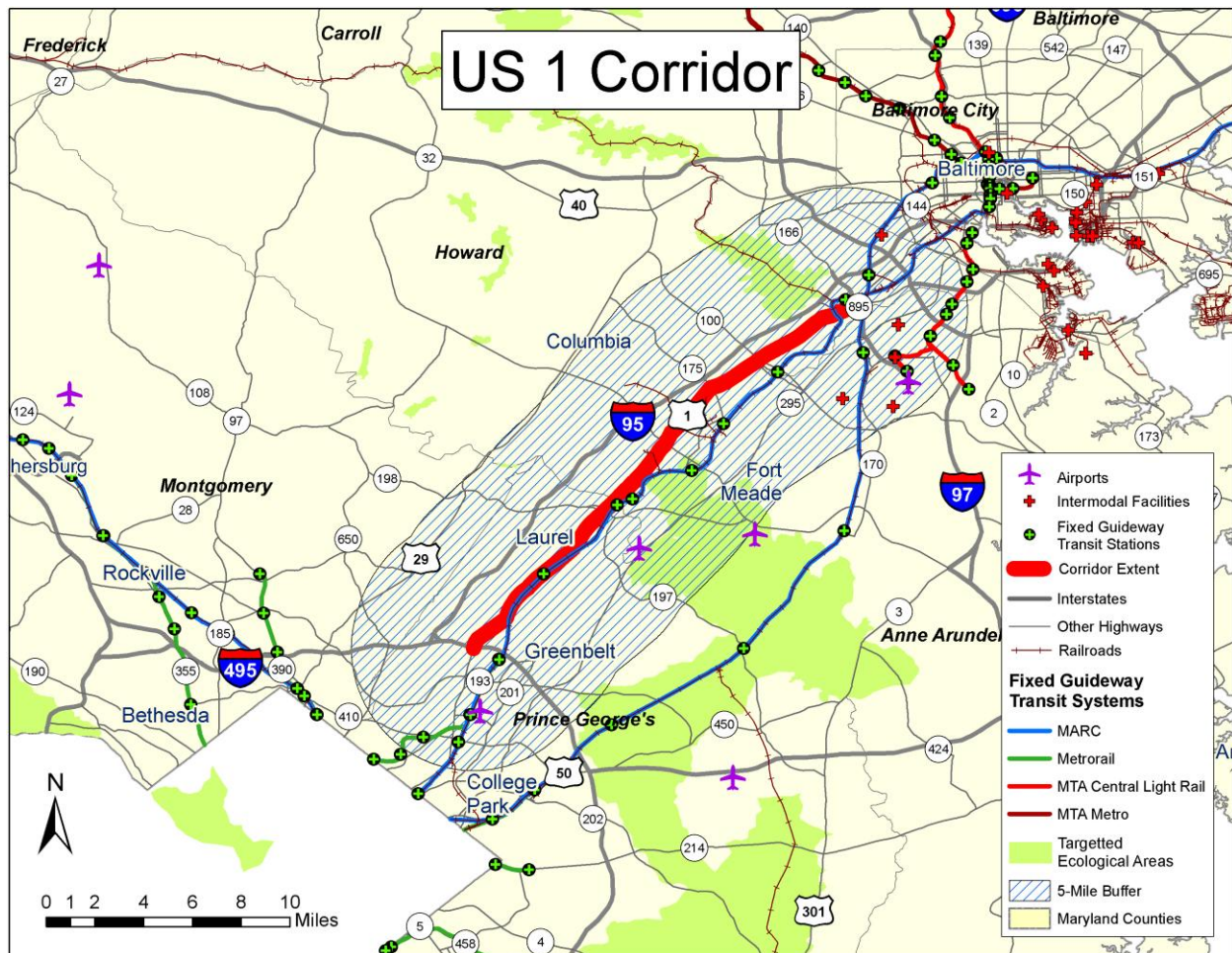
programs. However, this growth pattern significantly improves opportunities for carbon sequestration activities from agricultural and other undeveloped lands, including the two major reservoirs in the corridor.

Need – With high, comparatively uncontrolled growth in York County, PA, traffic volumes and congestion will continue to increase on I-83. Already operating at LOS F for most segments south of Shawan Rd. during the peak periods, congestion will spread and impact parallel facilities like MD 45 in the future. Minimizing congestion impacts will require level of service improvements on transit and commuting options, and selective capacity expansions and ITS deployments to reduce congestion at corridor bottlenecks. High corridor truck volumes and lack of truck parking facilities result in corridor safety issues as well as additional GHG emissions from idling.

Feasibility – The potential level and cost of transportation investment in this corridor is very high, particularly if it includes major expansion to I-83. There has not been expansive recent planning and public outreach in the corridor like the other corridors under consideration; however, as the number of jurisdictions involved is minimal this may not be a large concern. The feasibility of attaining significant emission offsets in the corridor is high given the progressive nature of Baltimore County's rural area planning. Developing strategies that address the negative impacts of growth in Pennsylvania is a significant challenge.

Complexity – The travel markets on I-83 clear and logical travel, there are no major parallel travel corridors and corridor needs are primarily focused on the I-83 mainline and intersecting facilities. Growth guidelines are comparatively prescriptive in Baltimore County; the goal is to maintain economic growth within the PFAs, particularly adjacent to the light rail line. The presence of I-695 within the corridor presents the most complex issues as the corridor distributes vehicle travel throughout the Baltimore region while also serving as a bypass of Baltimore City. These trips require a completely different set of strategies than what is needed to address transportation issues on I-83. The influence of growth and development in Pennsylvania as well as interstate truck travel will provide additional complexity to addressing carbon emission reductions in this corridor.

US 1 CORRIDOR



The 23 mile US 1 corridor area represented by a 5 mile buffer around the corridor includes I-95, MD 295 and the MARC Camden line. US 1 is classified as a principal arterial and runs parallel between I-95 and MD 295, intersecting with major state highways including MD 32, MD 175 and MD 100. The roadway is not access controlled, with a high incidence of driveways and signalized intersections. Generally 1 mile or less to the east of US 1 is the MARC Camden line with stations at Greenbelt, Muirkirk, Laurel, Laurel Park, Savage, Jessup and Dorsey. In the same rail corridor is the heavily traveled CSX Atlantic Coast Corridor. The MARC Penn line/Amtrak crosses into the corridor at the BWI Airport station.

Opportunity – The existing and future development and transportation context of the US 1 corridor presents high potential for GHG reduction in terms of mode shift from SOV trips resulting from improved transit, bike and pedestrian infrastructure and transit oriented development. Jobs housing balance within the corridor reflects high opportunity for living close to where you work. Further investigation of housing and employment characteristics is also likely to reveal a diverse mix of opportunities. The majority of growth is occurring within PFAs



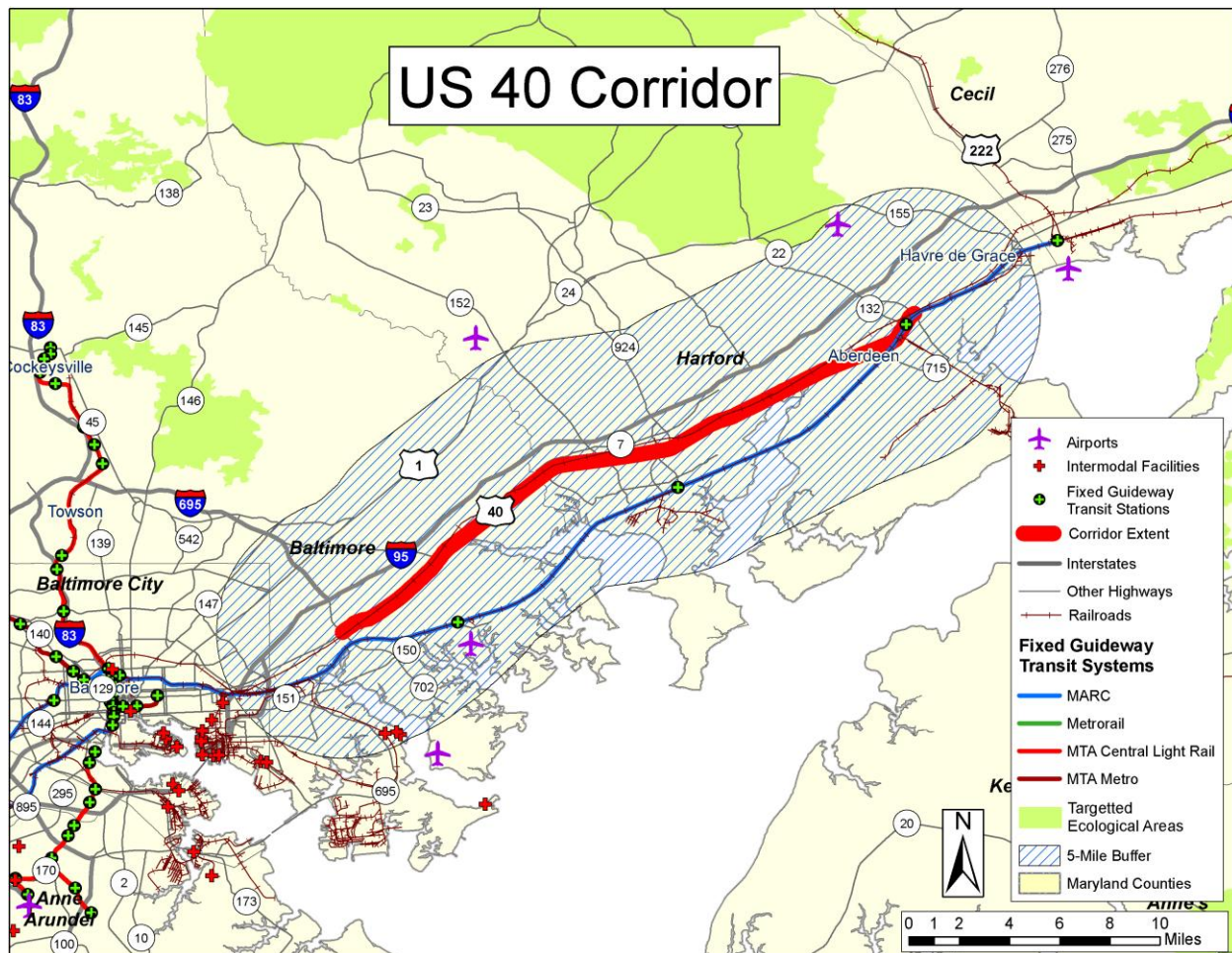
with a focus on large scale transit oriented development at or nearby MARC stations. As a result of high growth, opportunities for conservation and carbon sequestration activities are under pressure. The US 1 corridor currently rates at the low end for these opportunities.

Need – The US 1 corridor is forecast to experience high growth, which will continue to increase congestion, both on US 1 and parallel facilities such as I-95 and MD 295. Minimizing congestion impacts resulting from larger scale developments like Konterra and Fort Meade, while at the same time offering high level of service transit and commuting options should mitigate increasing carbon emissions from development generated new VMT.

Feasibility – The potential level and cost of transportation investment in this corridor is very high, particularly if a Green line METRO extension to Laurel or through Fort Meade to BWI Airport becomes a focused strategy for carbon neutrality. Addressing congestion impacts of growth on I-95 or MD 295 will also require significant levels of investment. Recent planning and public outreach in the corridor for BRAC and Howard County US 1 studies have established existing stakeholder groups and focused on common goals for corridor improvements. The corridor is below average in terms of opportunities of controlling carbon emissions utilizing offsets from the natural environment.

Complexity – The following features make US 1 the most complex corridor under consideration: location parallel to I-95 and MD 295, connection between two major metropolitan areas, a diverse and disordered mix of land uses and transportation activities, and the number of jurisdictions, municipalities, institutions and major employers which will have a stake in providing guidance on corridor goals and solutions. The corridor includes 9 distinct jurisdictions, including Fort Meade. Ft Meade includes the NSA's 650-acre campus and over 20,000 employees making it the largest employer in Maryland.

US 40 CORRIDOR



The 25 mile US 40 corridor area represented by a 5 mile buffer around the corridor intersects I-695, MD 43, MD 152, MD 24 and MD 22. US 40 runs parallel to the MARC Penn line, Amtrak Northeast Corridor and I-95 (generally 1 mile or less to the west). US 40 is classified as a principal arterial and has uncontrolled access along the length of the corridor. The corridor is not heavily developed, maintains a 4-6 lane cross-section for all of its length and has higher speed limits (55mph+) in less developed areas between Aberdeen, Edgewood and White Marsh. MARC stations in the corridor include Martin State Airport, Edgewood and Aberdeen. Amtrak also serves Havre de Grace. The CSX Atlantic Coast Corridor runs directly alongside or within a ½ mile of US 40 for the length of the corridor.

Opportunity – The US 40 corridor provides an average potential for GHG reduction in terms of mode shift from SOV trips. Existing and future jobs housing balance within the corridor reflect a large potential change in commute trip lengths, particularly as growth associated with BRAC in the Aberdeen area. New trips generated by growth at Aberdeen Proving Ground (APG) can be accommodated by expansion of MARC service as well as MTA commuter bus and Harford



County transit. The US 40 corridor rates high for sequestration opportunities due to a comparatively larger share of natural land uses, particularly adjacent to the Chesapeake Bay.

Need – The US 40 corridor is forecast to experience average growth compared to the central Maryland region, with particularly high growth around APG and White Marsh. The growth will increase VMT and roadway congestion in the corridor. Improvements to I-95 in Baltimore County will improve overall corridor travel conditions and establish a HOT lane system, however the impact on congestion on US 40 in Baltimore County is uncertain. In Harford County, US 40 is relatively uncongested, although proposed growth and infrastructure improvements on US 40 will need to be planned coincidentally. Minimizing congestion impacts resulting from development, while at the same time offering high level of service transit and commuting options should mitigate increasing carbon emissions from development generated new VMT.

Feasibility – The potential level and cost of transportation investment in this corridor is less than most other corridors given the focus on improving local transit circulation, deploying TDM strategies and localized roadway capacity improvements. Proposed expansion of MARC services along the Penn Line have been identified in the MARC Growth and Investment Plan. Recent planning and public outreach in the corridor for BRAC have established existing stakeholder groups and focused on common goals for corridor improvements. Given current resource preservation activities and green infrastructure planning in Harford County and the connection of US 40 to the Chesapeake Bay, the feasibility of conservation and restoration activities in this corridor are high.

Complexity – US 40 is less complex in terms of travel patterns because it is less congested, still contains large areas of little or no development and, given its location parallel to I-95, it does not carry a large share of through trips. It provides parallel access to I-95 for development in Aberdeen, Edgewood, Joppatown and White Marsh. I-95 and I-695 represent the majority share of corridor VMT, completely outweighing the emissions impact of VMT and delay on US 40. The two primary jurisdictions, Baltimore and Harford counties, reflect similar goals for the US 40 corridor in their county general development plans. The other significant stakeholder in the corridor is representatives of APG and the Department of Defense.



MD 175 Corridor

Legend:

- Airports (Purple airplane icon)
- Intermodal Facilities (Red star icon)
- Fixed Guideway Transit Stations (Green circle icon)
- Corridor Extent (Red line)
- Interstates (Thick grey line with blue shield)
- Other Highways (Thin grey line)
- Railroads (Red line with cross-ticks)

Fixed Guideway Transit Systems

- MARC (Blue line)
- Metrorail (Green line)
- MTA Central Light Rail (Red line)
- MTA Metro (Dark red line)

Other Features:

- Targetted Ecological Areas (Light green shading)
- 5-Mile Buffer (Blue hatched area)
- Maryland Counties (Yellow shading)

Map Labels: Howard, Columbia, Baltimore, Severn, South Gate, Fort Meade, Odenton, Greenbelt, Crofton, Prince George's, Anne Arundel, Baltimore City.

Scale: 0 to 10 Miles

North Arrow: N

Opportunity – The MD 175 corridor presents an average potential for GHG reduction in terms of mode shift from SOV trips resulting from improved transit, bike and pedestrian infrastructure and transit oriented development. In addition, relieving existing capacity constraints on MD 175 south of US 1 will relieve congestion and wasted fuel. Existing and future jobs housing balance within the corridor reflects less of an opportunity for living close to employment opportunities. However, it is expected that a large share of employees at Fort



Meade will live in Anne Arundel County. There is significant opportunity for expanding commuter benefits programs through the BWI Business Partnership, which already manages commute programs at Fort Meade and Arundel Mills. As a result of high growth, land uses that currently provide opportunities for conservation and carbon sequestration activities may be developed. There is opportunity to protect this land in the near term to ensure sustainable conservation practices and benefits over the long term.

Need – The MD 175 corridor is forecast to experience growth exceeding the BMC regional average, as well as all other corridors considered in this evaluation, with higher levels of growth expected around Fort Meade and Odenton. The growth will increase VMT and roadway congestion in the corridor. Minimizing congestion impacts resulting from development, while at the same time offering high level of service transit and commuting options, should mitigate increasing carbon emissions from development generated new VMT. This is the only non-radial corridor under consideration. The cross-county movement between Anne Arundel and Howard Counties is forecast to continue to grow and lead to increased congestion.

Feasibility – The potential level and cost of transportation investment in this corridor may not be as significant as other corridors given the focus on improving local transit circulation, deploying TDM strategies and localized roadway capacity improvements. Recent planning and public outreach in the corridor for BRAC have established existing stakeholder groups and focused on common goals for corridor improvements. The corridor is above average in terms of opportunities of controlling carbon emissions utilizing offsets from the natural environment, with the Patuxent Wildlife Refuge within the corridor area.

Complexity – MD 175 is complex in terms of travel patterns because it serves as both a commute and local trip corridor and, given its location parallel to MD 32 and MD 100, east-west trips are split across multiple facilities. It provides access from I-95 to employment and attractions in Columbia, and to Fort Meade. The corridor crosses multiple high-volume facilities with a large share of thru trips, including US 29, I-95, MD 295 and the MARC Camden and Penn lines. These cross-corridor facilities represent a majority share of total corridor trip activity. The two primary jurisdictions, Howard and Anne Arundel counties reflect similar goals for the MD 175 corridor in their county general development plans. The other significant stakeholder in the corridor is representatives of Fort Meade and the Department of Defense. Ft Meade includes the NSA's 650-acre campus and over 20,000 employees making it the largest employer in Maryland.

Table C.1 Carbon Neutral Corridor Final Screening Results

Criteria	Attributes from Available Data	Detailed Screening Mechanisms	Corridors					
			I-795	I-795/ MD 140	I-83	US 1	US 40	MD 175
1. Modal mix	Share of corridor population with walk access to transit	Population within 1/2 mile fixed guideway stations, 1/4 mile bus stops	35.2%	34.0%	41.3%	54.0%	33.4%	39.7%
	Share of corridor employment with walk access to transit	Employment within 1/2 mile fixed guideway stations, 1/4 mile bus stops	25.8%	18.3%	24.1%	45.1%	14.6%	32.1%
	Annual revenue miles per transit accessible population	Annual weekday transit revenue miles per transit accessible population	0.3	0.2	0.6	0.2	0.2	0.3
	Average corridor park and ride lot utilization	Per 2008 utilization statistics for SHA and MTA lots	59.0%	59.0%	32.0%	72.0%	86.0%	80.0%
2. Consistency and logic of travel within and through the corridor	Average peak period corridor LOS	Average all links A-F on corridor, develop corridor average (1 - 6)	3.9	4.6	4.7	4.7	4.3	4.5
	Corridor cordon line AADT growth rates (2000 - 2006)	BMATS cordon line analysis (BMC)	0.30%	0.30%	2.65%	0.27%	2.39%	-
	Jobs - housing balance (BMC region in 2000 = 0.61)	2000 population and employment data compared to regional average	0.60	0.61	1.05	0.77	0.67	0.43
	Jobs - housing balance (BMC region in 2035 = 0.67)	2035 population and employment forecasts compared to regional average	0.64	0.61	1.04	1.08	0.96	0.53
3. Transferability of strategies to other areas and corridors	Average annual population growth rate (2000 - 2035)	Compare to BMC regional forecast annual growth (0.69%)	0.41%	0.61%	0.29%	0.50%	0.49%	0.70%
	Initial screening criteria transferability estimates	0 - Not consistent, 1 - Partly consistent, 2 - Consistent with other growth areas	2	2	1	2	2	2
4. Land use mix along with the level and intensity of growth – existing and planned	Total corridor new household development capacity		11,475	18,990	7,837	42,864	30,374	32,450
	Household development capacity within PFAs		71%	59%	64%	99%	83%	87%
	Share of forecast population growth inside PFAs	Share of total corridor population growth in PFA's, 2000 to 2035	73%	57%	63%	79%	100%	76%
	Share of forecast employment growth inside PFAs	Share of total corridor employment growth in PFA's, 2000 to 2035	89%	82%	90%	72%	99%	95%
	Split of developed v. undeveloped land	Per 2002 MDP generalized land use	47/53	38/62	39/61	55/45	45/55	46/54
	For developed land, split of residential v. non-residential	Per 2002 MDP generalized land use	80/20	82/18	83/16	62/38	63/37	67/33

Criteria	Attributes from Available Data	Detailed Screening Mechanisms	Corridors					
			I-795	I-795/ MD 140	I-83	US 1	US 40	MD 175
	2000 Corridor Population Density (ppsm)	Population density per BMC socio-economic data	1,836	1,188	1,212	2,553	1,424	1,598
	2035 Corridor Population Density (ppsm)	Population density per BMC socio-economic data	2,122	1,469	1,341	3,043	1,692	2,040
6. Mix and complexity of the natural environment	Conservation opportunities - unprotected natural areas with a high potential for carbon sequestration	Overlay and scoring of protected lands, forests/wetlands, targeted ecological areas, green infrastructure hubs and corridors	43	65	76	61	100	74
	Restoration Opportunities - focus on areas that could be reforested to sequester carbon, regardless of land ownership	Overlay and scoring of agricultural lands, targeted ecological areas, green infrastructure gaps, floodplains and intertidal zones	42	100	77	30	47	49
7. Consistency with MDOT initiatives	Recently completed or underway corridor planning/evaluation	Number of major studies/projects underway or recently completed	2 - 3	2 - 3	<= 2	3+	3+	3+
8. Ability to define logical boundaries	Description of governmental and geographic boundaries	Number of governmental units in corridor (including DOD facilities)	2	4	3	9	5	6
9. Public and private support for the analysis and willingness to be a demonstration model	Review local comprehensive plans, zoning for supportive plans/policies at local level		Y	Y	Y	Y	Y	Y
	Description and level of involvement in climate change related programs	Average level of support tier (1 - high, 2 - mid, 3 - low)	1.0	1.33	1.0	1.5	1.5	1.66
10. Freight activity (rail, air, truck) within the corridor	Truck percentage	Per 2008 HPMS data (all trucks)	10%	10%	14%	5%	8%	8%
	Corridor total freight intensive employment	Per Statewide Freight Plan data and approach	14,388	17,963	13,769	61,710	30,549	37,524
	Intra-Maryland share of total corridor truck load equivalents	Per 2006 Transearch data	99.7%	99.6%	77.2%	-	100.0%	100.0%
11. Availability of supporting data	Based on assessment of current modeling tools and scope of recent studies		High	Average	Average	High	Average	High



D. Final Corridor Screening Maps

Figure D.1 Transportation Facilities

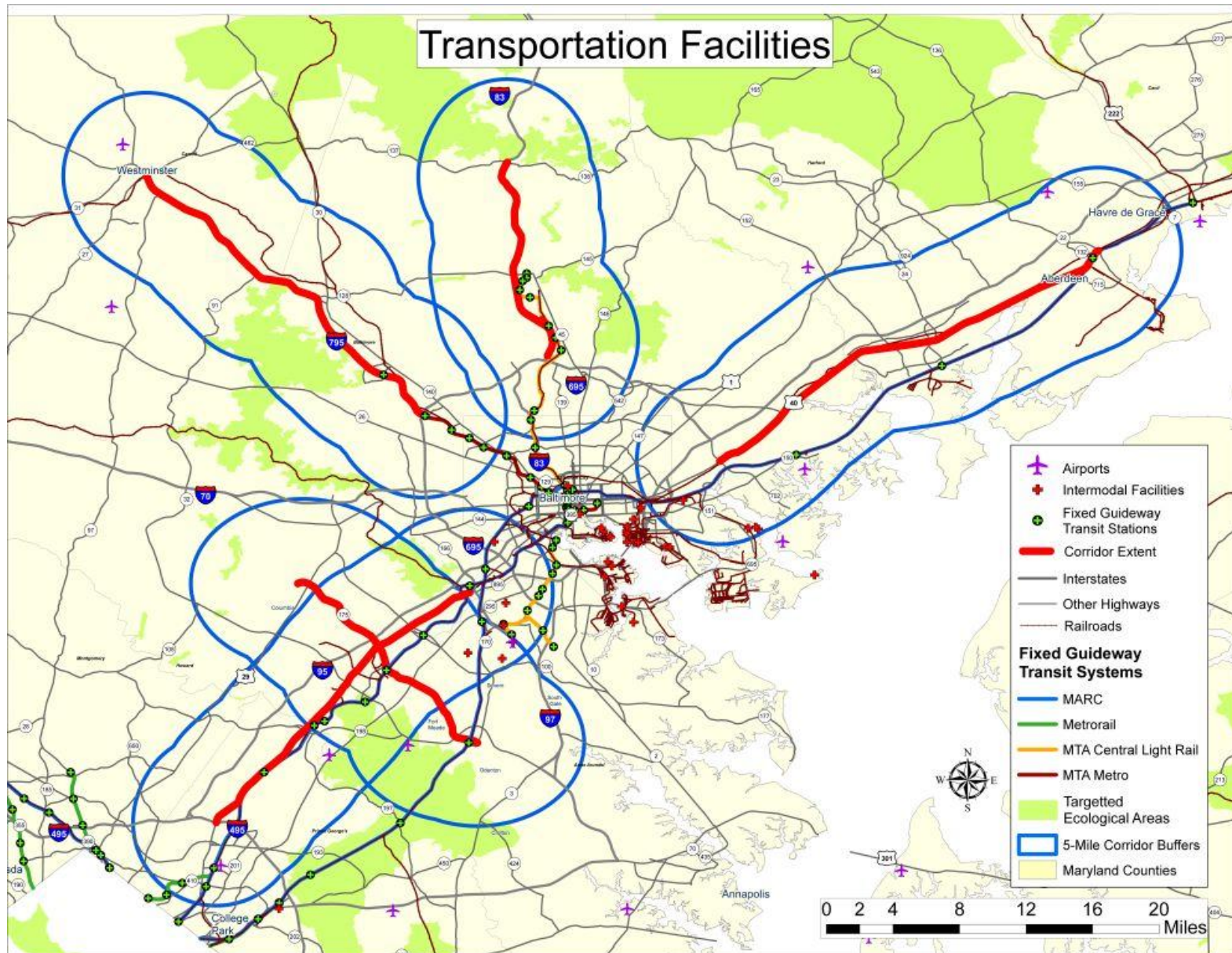


Figure D.2 Existing Land Use

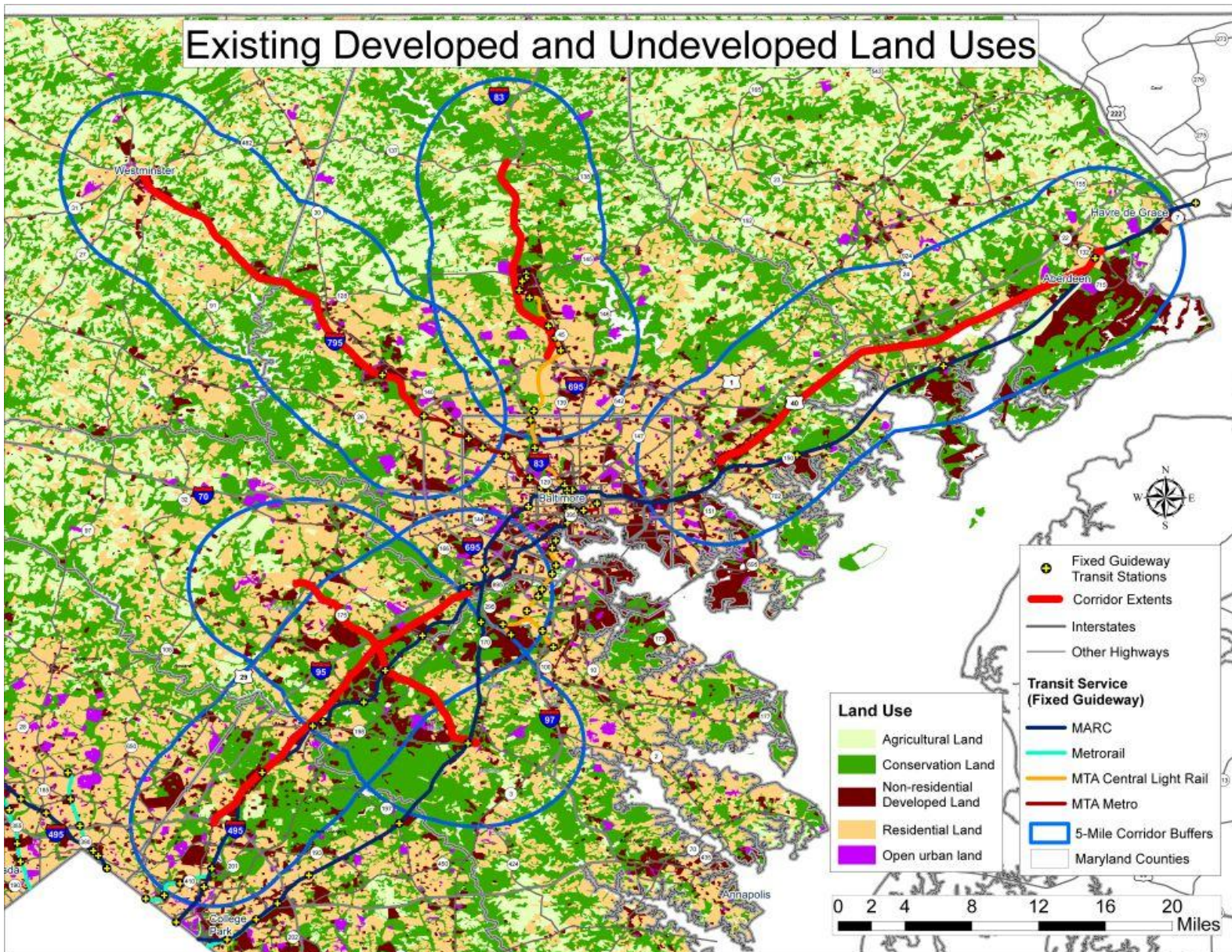


Figure D.3 Development Focus Areas

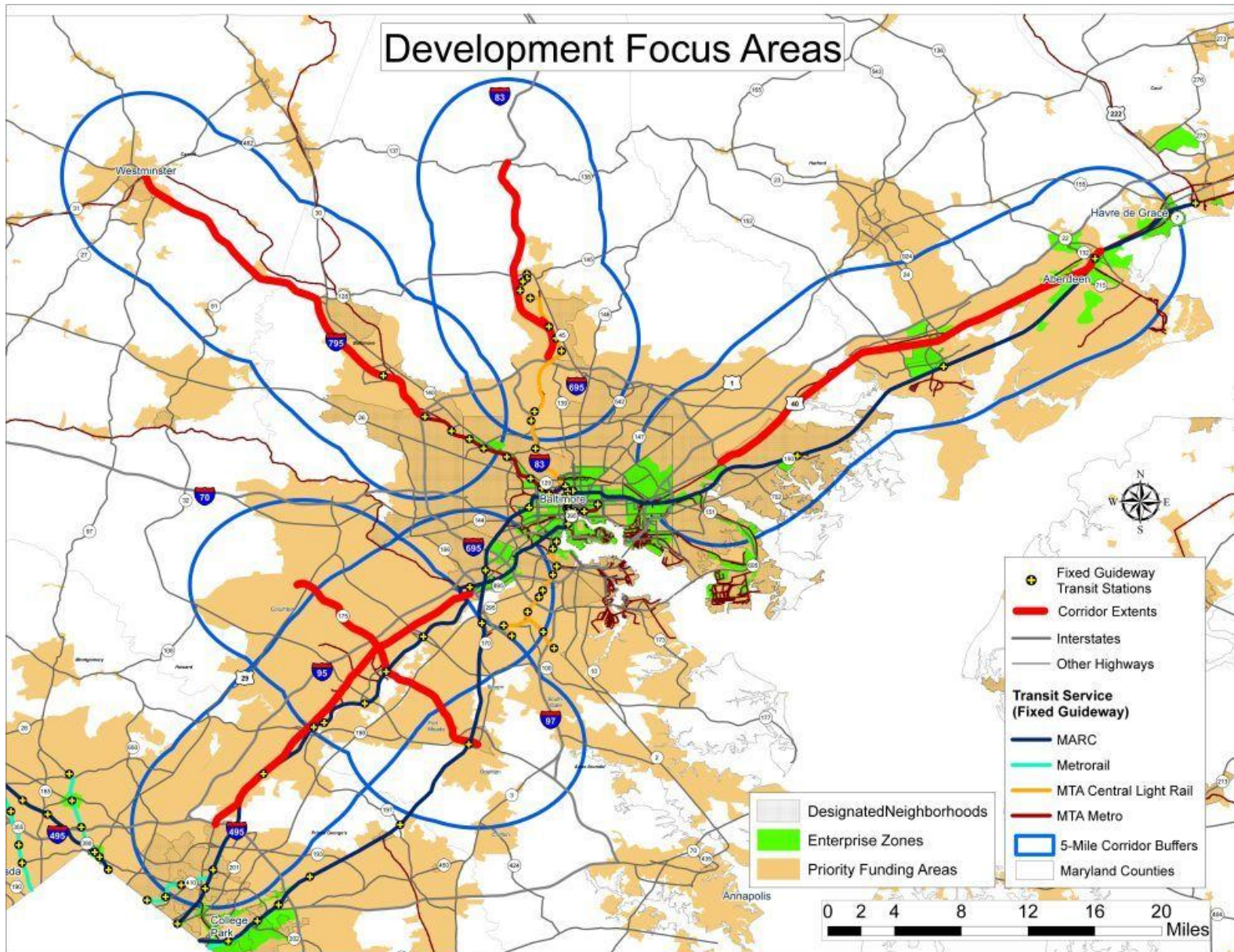
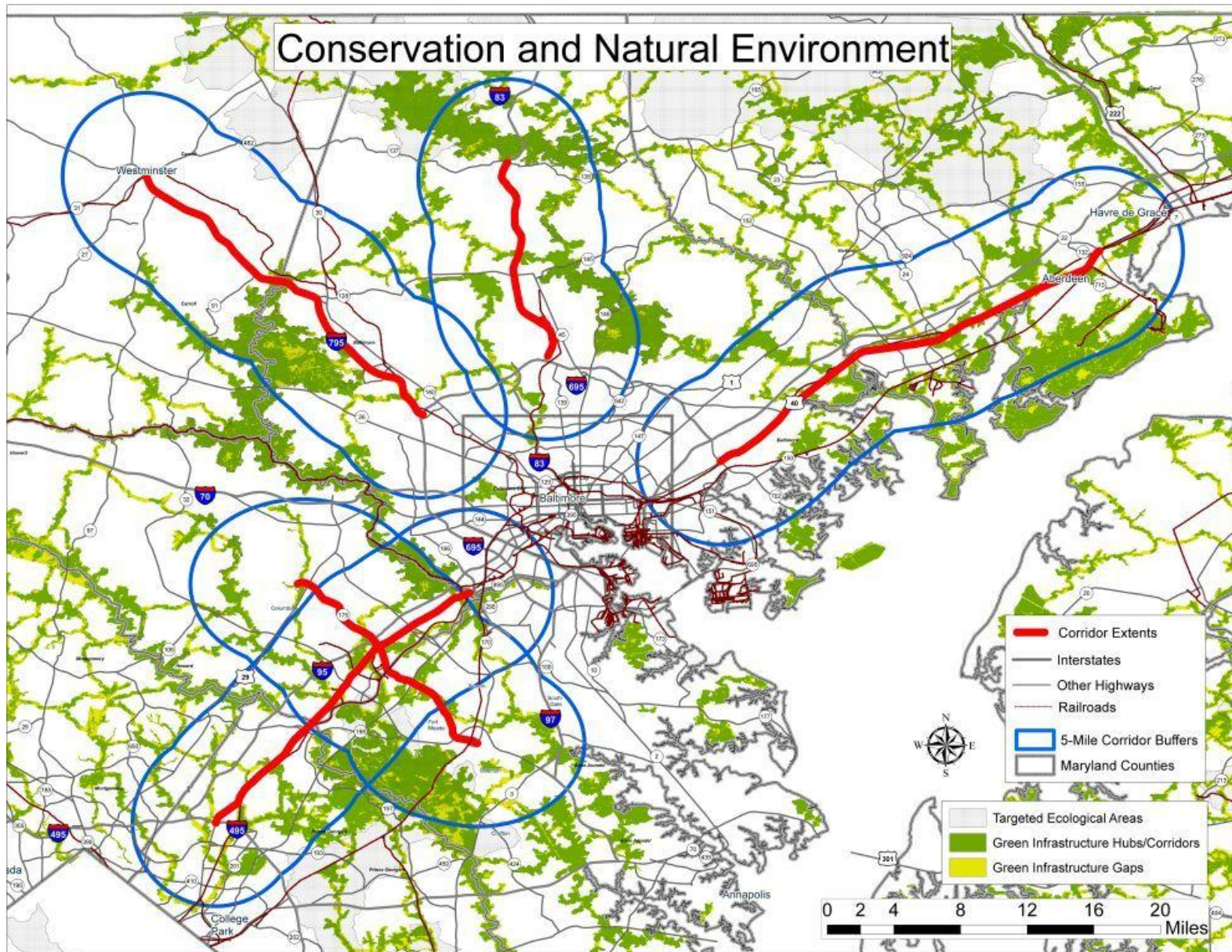


Figure D.4 Conservation and Natural Environment Areas





E. US 40 Corridor Planned Transportation Assets

DRAFT 2012-2017 CTP

PROJECT	LIMITS	DESCRIPTION	Cost (1000s)	Year
I-95 Express Toll Lanes	I-895 to MD 43	Construct two Express Toll Lanes in each direction and improve the interchanges with I-895, I-695 and MD 43.	\$355,356	2014
MD 24	MD 924 to MD 7	Phase 1 includes minor improvements to the I-95/MD 24 interchange and a grade-separated interchange at the MD24/MD 924 intersection.	\$8,089	2012
MD 755	MD 24 to Willoughby Beach Road	SHA Community Safety and Enhancements Program	\$3,961	complete
MD 755	Willoughby Beach Road to Edgewood MARC	SHA Community Safety and Enhancements Program	\$2,000	PE underway
MD 7	Rosedale Streetscape	Sidewalks and wide curb lanes	\$165	complete
US 40 - Pulaski Highway	US 40 from Middle River Road to south of MD 43 Interchange	Project will include roadway resurfacing and replacement of the median jersey barrier with an aesthetically treated divider, landscaping, bicycle and pedestrian improvements.	\$1,900	PE underway
US 40 - Pulaski Highway	Mohrs Lane intersection	SHA Community Safety and Enhancements Program	\$250	PE underway
US 40	MD 715 interchange	Interchange improvement to accommodate BRAC traffic growth.	\$24,639	2013
US 40	MD 7 intersection	The project includes capacity and geometric improvements to the safety and operations of the intersection.	\$4,255	2013
MARC Edgewood Station		Phase II improvements include replacement of the existing station with a permanent building and site enhancements to enhance customer service and provide improved ADA access.	\$4,300	2014
MARC Improvements Camden, Brunswick and Penn Lines ¹	Statewide	Ongoing improvement program of the MARC Camden, Brunswick and Penn lines to ensure safety and quality of service.	\$124,717	ongoing
12 low-floor hybrid expansion buses	Harford County	ARRA funding – Harford County approved the purchase of 8 low-floor buses, Nov. 17 th , 2011	\$4,212	2011

¹ Costs represent statewide project capital cost estimates. Program is implemented through CSX and Amtrak joint capital improvement agreements. On CSX projects, the existing signal system will be upgraded and three crossovers will be added to increase track capacity.



BRTB 2012-2015 TIP, Plan It 2035 Long-Range Transportation Plan and Baltimore and Harford County Capital Improvement Programs

PROJECT	LIMITS	DESCRIPTION	COST (\$000)	YEAR OPEN
Mohrs Lane bridge	Bridge over CSX RR	Replacement and widening of existing bridge to include sidewalks and larger lanes as well as the approaches to accommodate future Campbell Blvd.	\$6,600	2014
Baltimore Region Ridesharing Program	Baltimore Region	The ridesharing project covers the activities of the ridesharing program in all jurisdictions in the Baltimore region, including the Guaranteed Ride Home (GRH) Program.	\$5,457	ongoing
BRAC Related Intersections near APG	Harford County	Design and construct intersection improvements at key locations along access routes to Aberdeen Proving Ground. Bicycle and pedestrian facilities will be provided where appropriate.	\$11,653	2013
MD 7	Intersection at MD 43	Partial to full interchange	\$59,790	
MD 22	MD 543 to APG Gate	Widening of existing 2- to 3- lane section to 4 lanes, existing 4-lane section to 6-lanes; includes sidewalks and bicycle accommodations where appropriate	\$483,340	2025+
Red Line	Woodlawn to Bayview	New light rail line	\$2,220,480	2025+
Bayview MARC and Intermodal Station	Lombard Street at Bayview Blvd.	New MARC station to connect to Red Line	\$49,950	2025+
MARC Penn Line	Aberdeen Station	TOD and expanded station	\$46,210	2025+
MARC (Baltimore Region total)	Baltimore region	Improvements to MARC lines and facilities	\$482.810	2016 - 2035
Campbell Blvd.	MD 7 to MD 43	New 4-lane road	\$12,455	2014
Perryman Access - Mitchell Lane	Connect US 40 from Mitchell Lane to the Perryman Peninsula	New 2-lane road		2016
MD 24	Singer Road to US 1 Business	Widen from 4 to 6 lanes; includes sidewalks and bicycle accommodations where appropriate	\$209,350	2015
Yellow Brick Road	Extend to Middle River Road	Local street	\$4,300	2012
Rossville Boulevard	Lillian Holt Drive to I-95			
Cowenton Avenue	Joppa Road to Philadelphia Road	Widen from 2 to 4 lanes	\$4,800	2016
New Forge Road	Allender to Philadelphia Road			
Northeast Trail	From Elmwood ES to Joppa Rd.	Off-road trail linking residential communities with local schools, parks, and White Marsh Town Center	\$4,370	2016
Campbell Boulevard Trail	White Marsh Mall to MD 7	Parallels Campbell Blvd	\$100	2014
Lower Susquehanna Heritage Greenway	Conowingo Dam to Havre de Grace	Bike/pedestrian path	\$1,500	2016
Aberdeen Area Bikeway (MD 132)	Ripken Stadium to Aberdeen MARC Station	Bike lane	\$250	2016
Havre de Grace Bikeway	Juniata St to Tydings Park	Bike/pedestrian path	\$250	2016



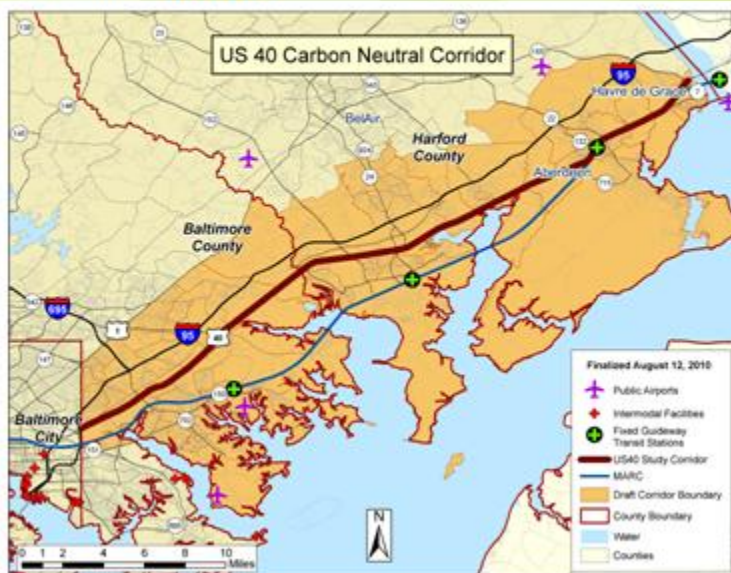
PROJECT	LIMITS	DESCRIPTION	COST (\$000)	YEAR OPEN
MD 152 Corridor Bikeway	Hess Road to Trimble Road	Bike lane	\$620	2016
MD 24 Bikeway	US 1 to Bel Air Pkwy	Bike lane	\$310	2016
Trimble Road Bikeway	Edgewood Park to Flying Point Park	Bike lane	\$310	2016
Winters Run Greenway	Tollgate Rd to Winters Run	Bike/pedestrian path	\$1,900	2015
Woodsdale /Waldon Road Bikeway	Woodsdale Rd to Edgewood Rd	Bike/pedestrian path, including bridge across I-95	\$7,870	2016
Joppa Greenway Trail	Foster Run Stream Valley Corridor	Bike/pedestrian path	\$3,000	2020



F. Trends Analysis Summary

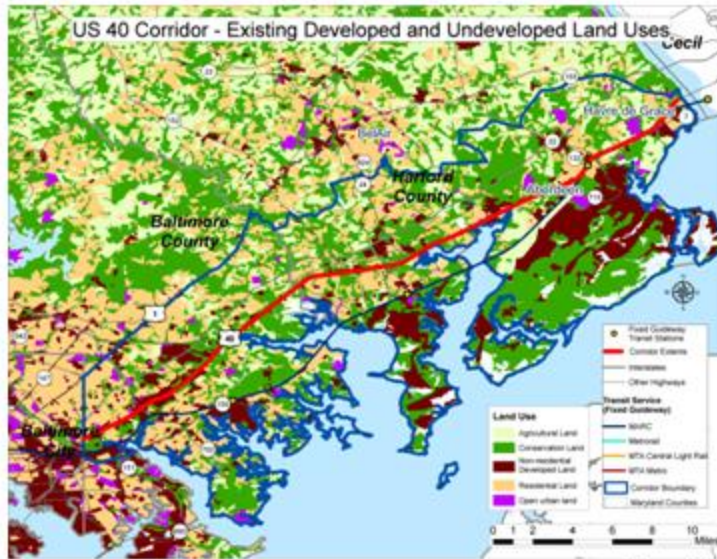
All slides are excerpts from the October 27th, 2010, corridor trends presentation to the Interagency Steering Committee Meeting.

IV. US 40 Corridor Trends Presentation Corridor Context



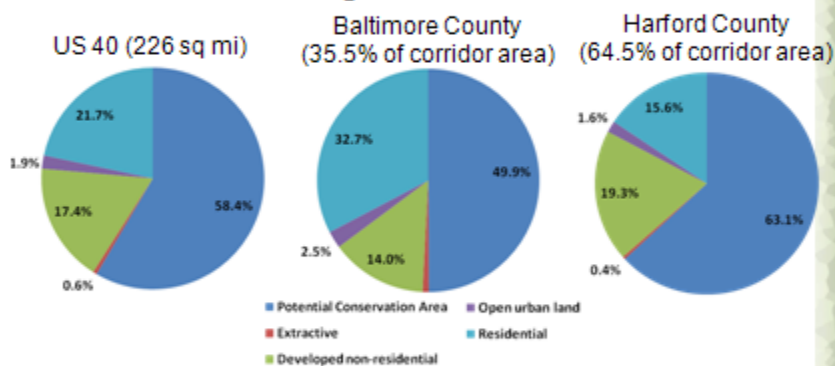


IV. US 40 Corridor Trends Presentation *Land Use, Development and Conservation*



IV. US 40 Corridor Trends Presentation *Land Use, Development and Conservation*

Existing Corridor Land Use



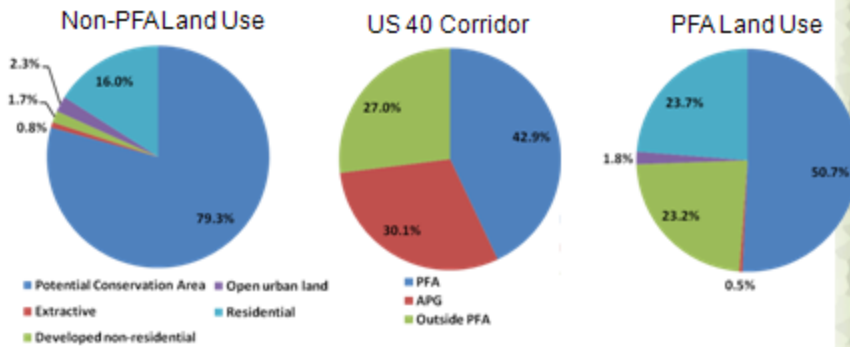
- Potential conservation areas include agriculture, forest, pasture, and wetlands
- Developed non-residential land includes commercial and industrial development in the Middle River/White Marsh area
- Retail & commercial centers in Joppatown, Edgewood, Perryman, Aberdeen and Havre de Grace, and Aberdeen Proving Ground (APG)

Source: MDP 2002 land use/land cover



IV. US 40 Corridor Trends Presentation *Land Use, Development and Conservation*

Existing Corridor Land Use – In and Out of PFAs

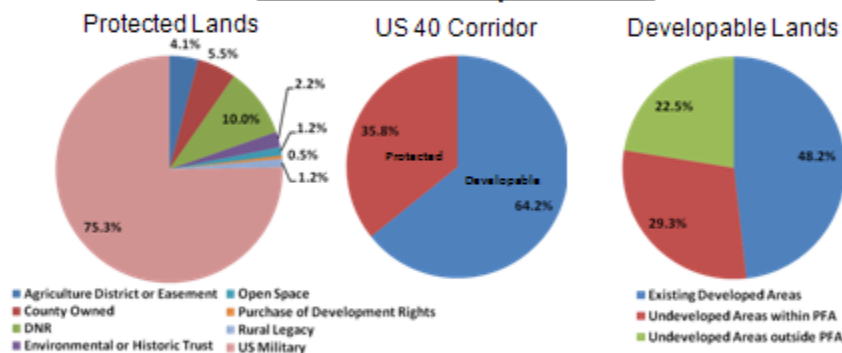


- Over half of the potential conservation area in PFAs are located within APG
- 82% of non-PFA land is currently undeveloped or used for agriculture
- Potential conservation areas covered by deciduous forest (61%), wetlands (11%)
- Deciduous forests and wetlands are focus areas for carbon sequestration

Source: MDP 2002 land use/land cover

IV. US 40 Corridor Trends Presentation *Land Use, Development and Conservation*

Protected v. Developable Lands

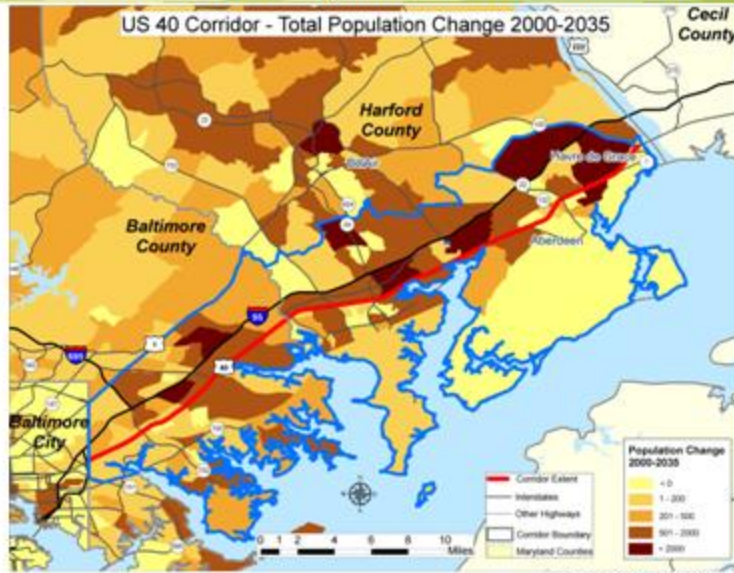


- 64% of land area is defined as developable – 48% is within existing developed areas and 29% is undeveloped within PFAs
- 55% of the land area of APG are potential conservation areas
- Development and redevelopment opportunities exist in the corridor (Baltimore County Pulaski Hwy. redevelopment)

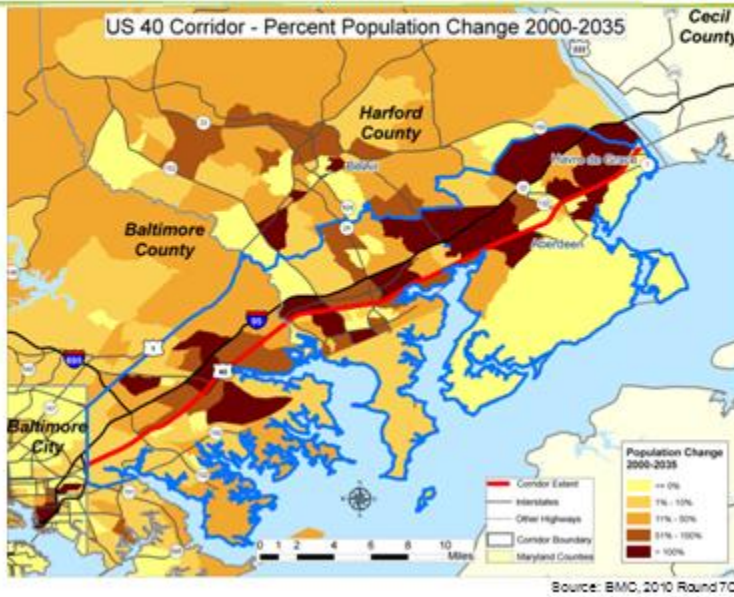
Source: MDP 2002 land use/land cover



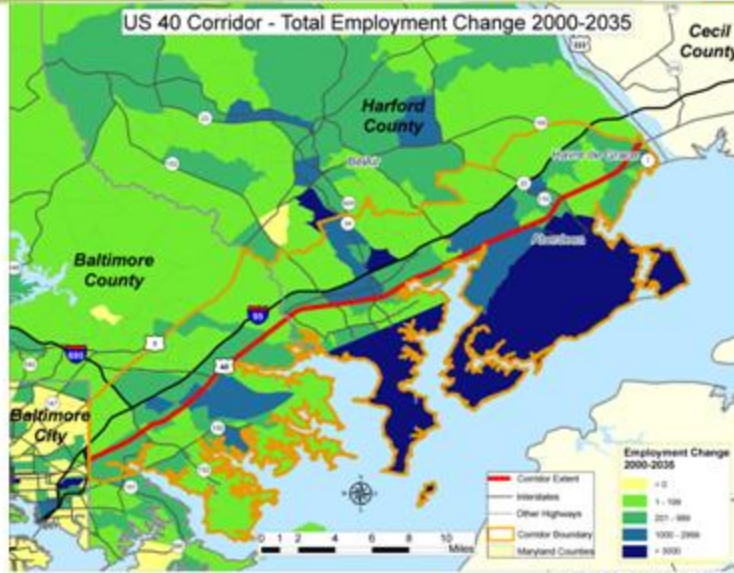
IV. US 40 Corridor Trends Presentation *Land Use, Development and Conservation*



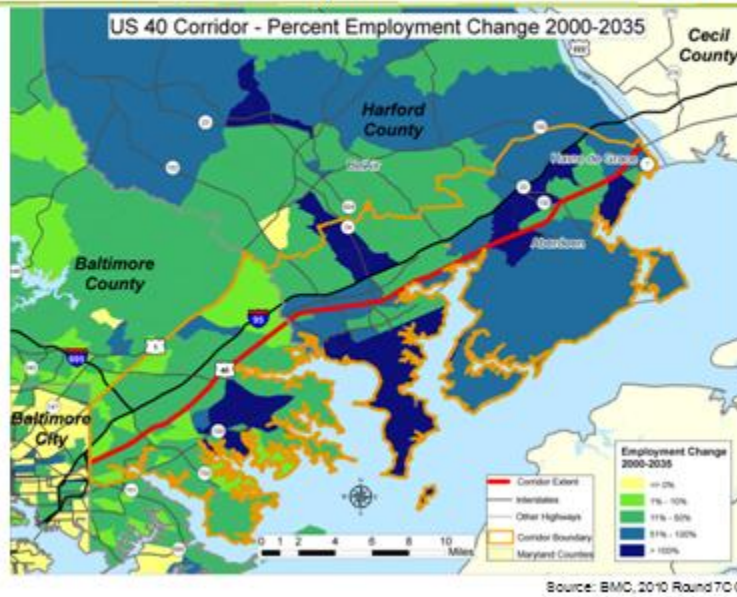
IV. US 40 Corridor Trends Presentation *Land Use, Development and Conservation*



IV. US 40 Corridor Trends Presentation *Land Use, Development and Conservation*



IV. US 40 Corridor Trends Presentation *Land Use, Development and Conservation*

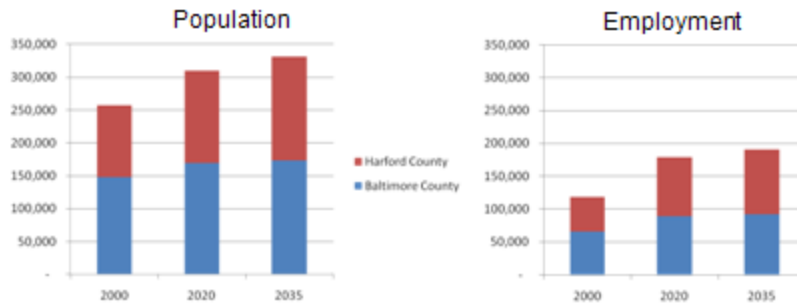




IV. US 40 Corridor Trends Presentation

Land Use, Development and Conservation

Socioeconomic Trends



- Greater than 97% of growth is forecast to occur in PFAs
- Job growth outpaces household and workforce growth (2 to 1)
- Corridor jobs to workers ratio increases from 0.9 in 2000 to 1.2 by 2035
- Harford County corridor population grows 46% and employment grows 88%
- The share of office employment in the corridor increases, but is still less than the regional share by 2035 (45% region, 40% corridor)

Source: BMD, 2010 Round 70 Cooperative Forecasts

IV. US 40 Corridor Trends Presentation

Transportation

US 40 Corridor Regional Trip Ends – Total Daily Person Trips

Total Daily Trip Ends (1000s)	2000	2035	% Growth
Trips Within Corridor	804.8	1,163.2	44.5%
Baltimore & Harford County	232.1	290.2	25.0%
Baltimore City	139.7	156.7	12.2%
Baltimore/DC Region	31.7	49.5	56.2%
I 95 North External Trips	28.5	57.8	102.8%
Remaining External Trips	10.0	16.8	68.0%
Corridor Total	1,247.0	1,734.2	39.1%

- Share of person trips staying within the corridor increase from 64% in 2000 to 68% in 2035
- Corridor employment growth attracts new trips from outside the corridor
- Average work trip length decreases from 10.3 miles (2000) to 9.2 miles (2035)

Source: BMD, 2000 & 2035 LRTP model runs



IV. US 40 Corridor Trends Presentation Transportation

US 40 Corridor Transit Mode Share Analysis

Transit Mode Share	2000	2035
Work trips	5.5%	4.7%
<i>Within Corridor</i>	2.4%	1.8%
<i>Baltimore & Harford County</i>	3.6%	4.0%
<i>Baltimore City</i>	12.4%	13.2%
All other trips	<0.5%	<0.6%
School trips	1.9%	1.6%

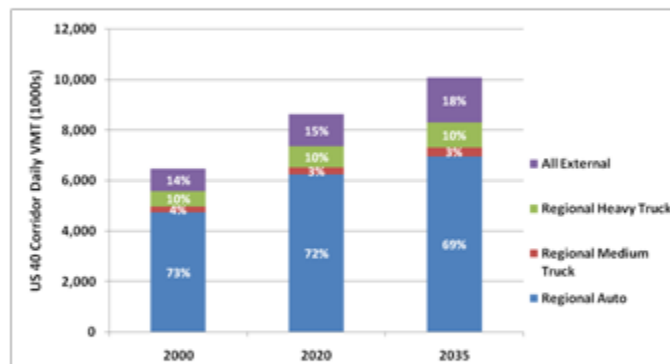
- Total transit mode share slightly decreases 1.2% to 1.1%
- Growth in trips entering and staying within corridor affect transit share
- 75% of all corridor transit trips are work trips
- 58% of all corridor transit trips are to/from Baltimore City

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Source: BMC, 2000 & 2035 LRTP model runs

IV. US 40 Corridor Trends Presentation Transportation

Weekday Corridor VMT by Vehicle Type and External Vehicle Trips



- Corridor VMT grows 56% from 2000 to 2035
- The annual VMT growth rate 2000 to 2020 is 1.5%
- The annual post-2020 VMT growth rate slows to 1.0%

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Source: BMC, 2000 & 2035 LRTP model runs



IV. US 40 Corridor Trends Presentation *Transportation*

PM Peak Period VMT by Level of Service – US 40 Corridor

	A	B	C	D	E	F
2000	7%	9%	20%	33%	29%	1%
2020	5%	10%	13%	26%	44%	2%
2035	3%	5%	19%	17%	53%	3%

- Congested peak period VMT increases from 30% in 2000 to 56% in 2035
- 80% of the congested VMT occurs on I 95 / I 695 in 2000 – decreasing to 77% in 2035
- The largest percent growth in congested VMT occurs on principal arterials – a result of the growth in internal corridor trips

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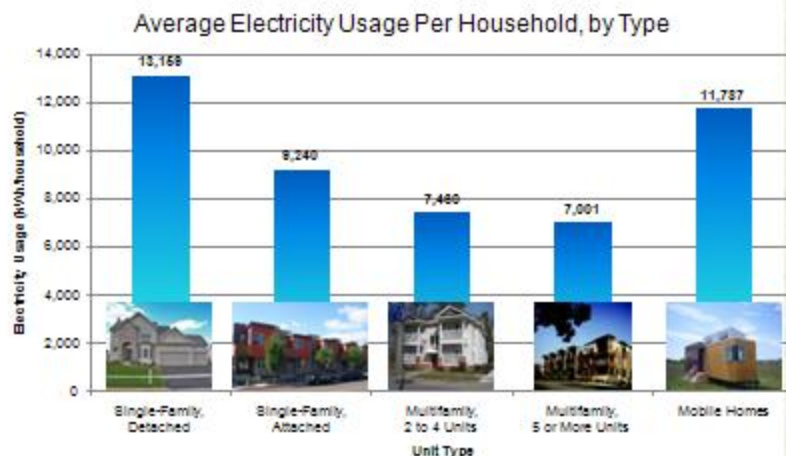
Source: BMD, 2000 & 2035 LRTP model runs

IV. US 40 Corridor Trends Presentation *Energy Consumption*

- US 40 Corridor electricity consumption increases based on population and employment growth
- **EmPOWER Maryland** establishes energy consumption rate goals and identifies actions and programs:
 - 15% Consumption Rate Reduction by 2015 through energy efficiency
 - Residential Strategies: Energy Efficient Appliance Rebates, Single and Multi Family Homes Efficiency Retrofits, Clean Energy Financing, Clean Energy Job Training
 - Industrial/Commercial Strategies: Energy Efficiency Low-Interest Loans, Energy Assessments
- The **Renewable Portfolio Standard (RPS)** establishes a target for the power generation sector plus incentives for homeowners and businesses to invest in clean energy technology:
 - Requires 20% of Maryland's electricity be generated from renewable sources by 2022, including 2% from solar energy
 - Will lower carbon footprint of electricity usage
 - Initiatives to encourage installation at the consumer level and utility level

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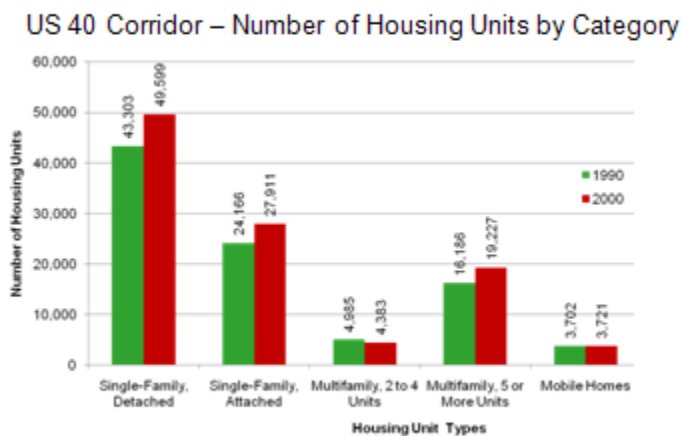
IV. US 40 Corridor Trends Presentation *Energy Consumption (Residential)*



Source: Energy Information Administration. 2005 Residential Energy Consumption Survey, Table U88.

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IV. US 40 Corridor Trends Presentation *Energy Consumption (Residential)*



- Change in corridor housing type from 1990 to 2000 result in virtually no annual household energy consumption growth (10,691 kwh to 10,699 kwh)

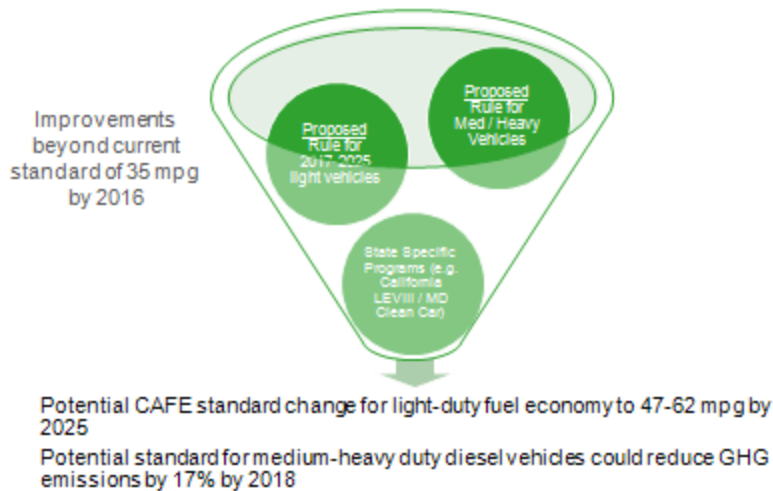
Source: Decennial US Census data for block groups in the corridor.
*Weighted average based on number of housing units in each type and average electricity usage by type from 2005 Residential Energy Consumption Survey, Table U88.

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IV. US 40 Corridor Trends Presentation *Energy Consumption (Federal Emission Standards)*

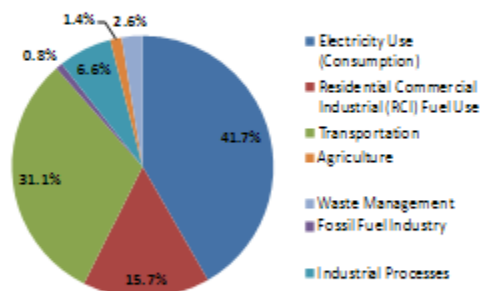
Proposed Federal and State Actions Impacting On-Road Fuel Consumption



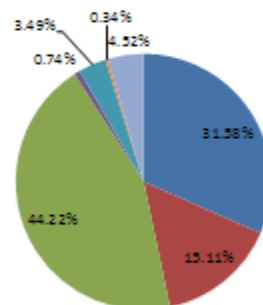
IV. US 40 Corridor Trends Presentation *GHG Emissions*

2006 Baseline GHG Emission Summary

CAP Baseline-Statewide



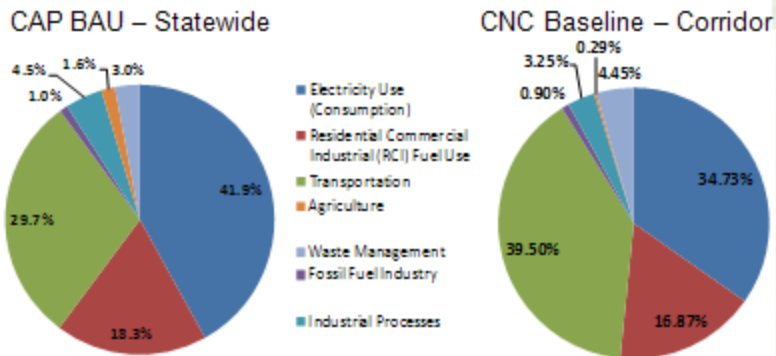
CNC Baseline-Corridor



- The US 40 corridor is 4.5% of the statewide inventory in 2006
- The transportation sector plays a more significant role in total GHG emissions (44% compared to 31% statewide)

IV. US 40 Corridor Trends Presentation GHG Emissions

2020 BAU GHG Emission Summary

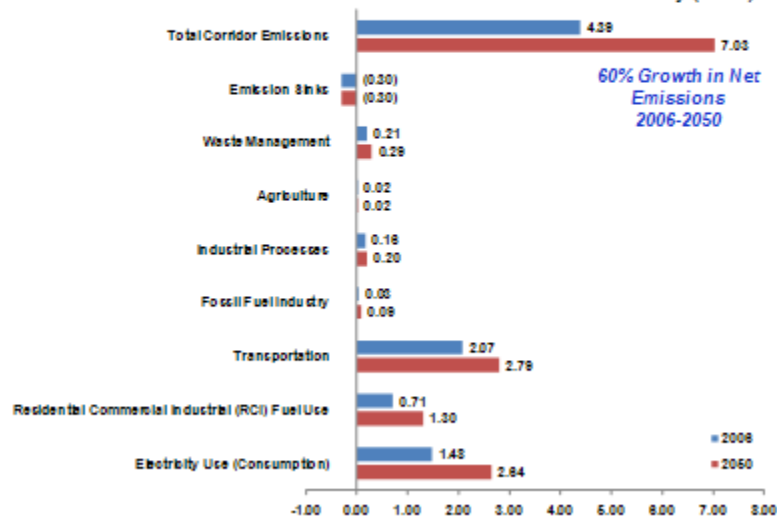


- The US 40 corridor remains 4.6% of the statewide inventory in 2020
- Transportation sector share of total emissions remains high compared to the State share (40% to 30%)

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IV. US 40 Corridor Trends Presentation GHG Emissions

2006 Baseline and 2050 BAU - GHG Emission Summary (mmt)

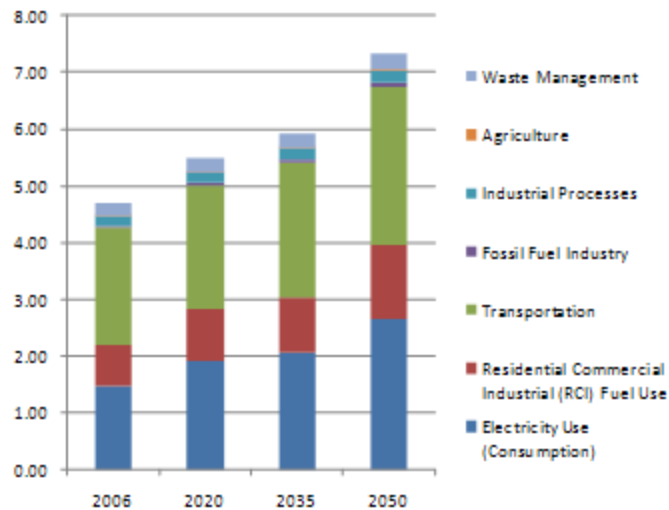


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IV. US 40 Corridor Trends Presentation GHG Emissions

2006 Baseline, 2020, 2035 and 2050 BAU - GHG Emission Summary (mmt)



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IV. US 40 Corridor Trends Presentation GHG Emissions – On Road Transportation

- What is included in the GHG inventory?
- On-Road inventory includes new car and light truck GHG emission standards affecting model years 2012-2016:

Projected Fleet-Wide CAFE Fuel Economy Levels (Per May 7, 2010 EPA/NHTSA Final Rule)					
	2012	2013	2014	2015	2016
Passenger Car	32.3	33.5	34.2	35.0	36.2
Light Truck	24.5	25.1	25.9	26.7	27.5
Combined	28.7	29.7	30.6	31.5	32.7

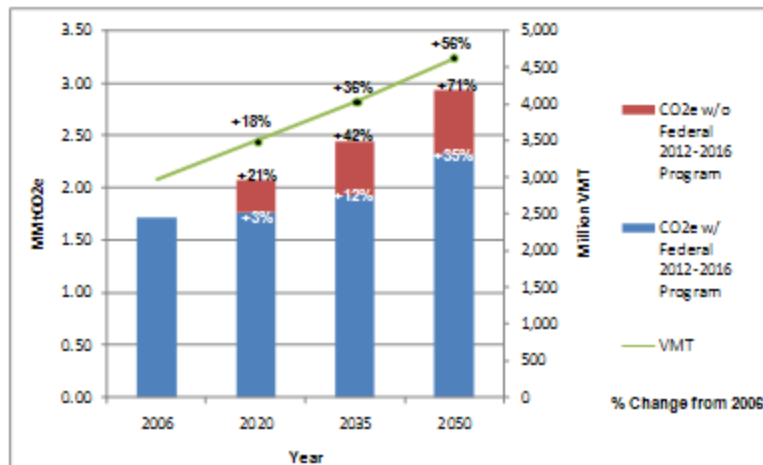
Table I.B.2-2 Federal Register Vol 75, No. 88 – May 7, 2010

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IV. US 40 Corridor Trends Presentation GHG Emissions – On Road Transportation

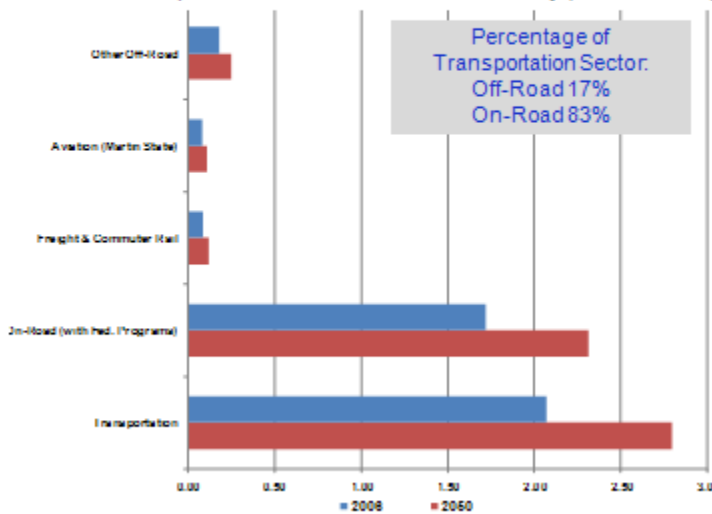
Transportation Sector GHG Emissions and VMT



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IV. US 40 Corridor Trends Presentation GHG Emissions – Off Road Transportation

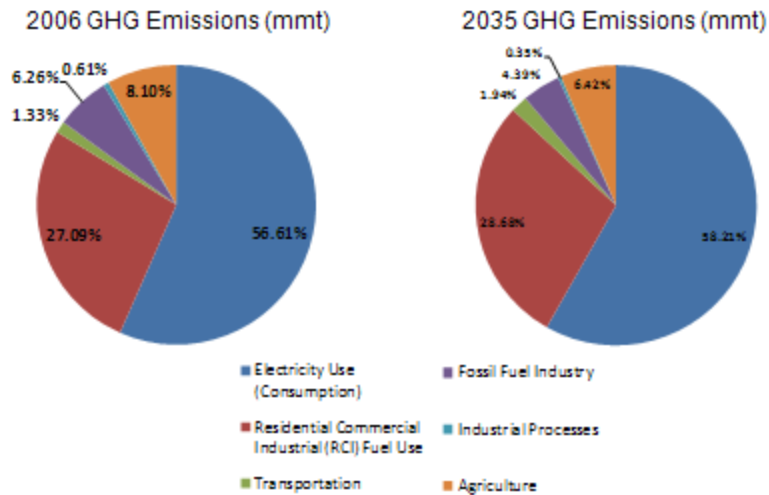
Off-Road Transportation GHG Emissions Summary (2006 & 2050)



35



IV. US 40 Corridor Trends Presentation GHG Emissions – Non Transportation



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IV. US 40 Corridor Trends Presentation GHG Emissions – Non Transportation

MMTCO ₂ E	2006	2050	2006-2050
Total Energy Use	2.22	4.03	81%
Electricity Use (Consumption)	1.48	2.64	79%
Residential	0.74	1.08	
Commercial	0.62	1.30	
Industrial	0.12	0.26	
Electricity Production (C.P. Crane)	1.89	1.89	0%
Residential/Commercial/Industrial (RCI) Fuel Use	0.71	1.30	84%
Residential	0.30	0.44	
Commercial	0.17	0.35	
Industrial	0.24	0.51	
Fossil Fuel Industry	0.0347	0.0882	154%
Natural Gas Industry	0.03	0.09	

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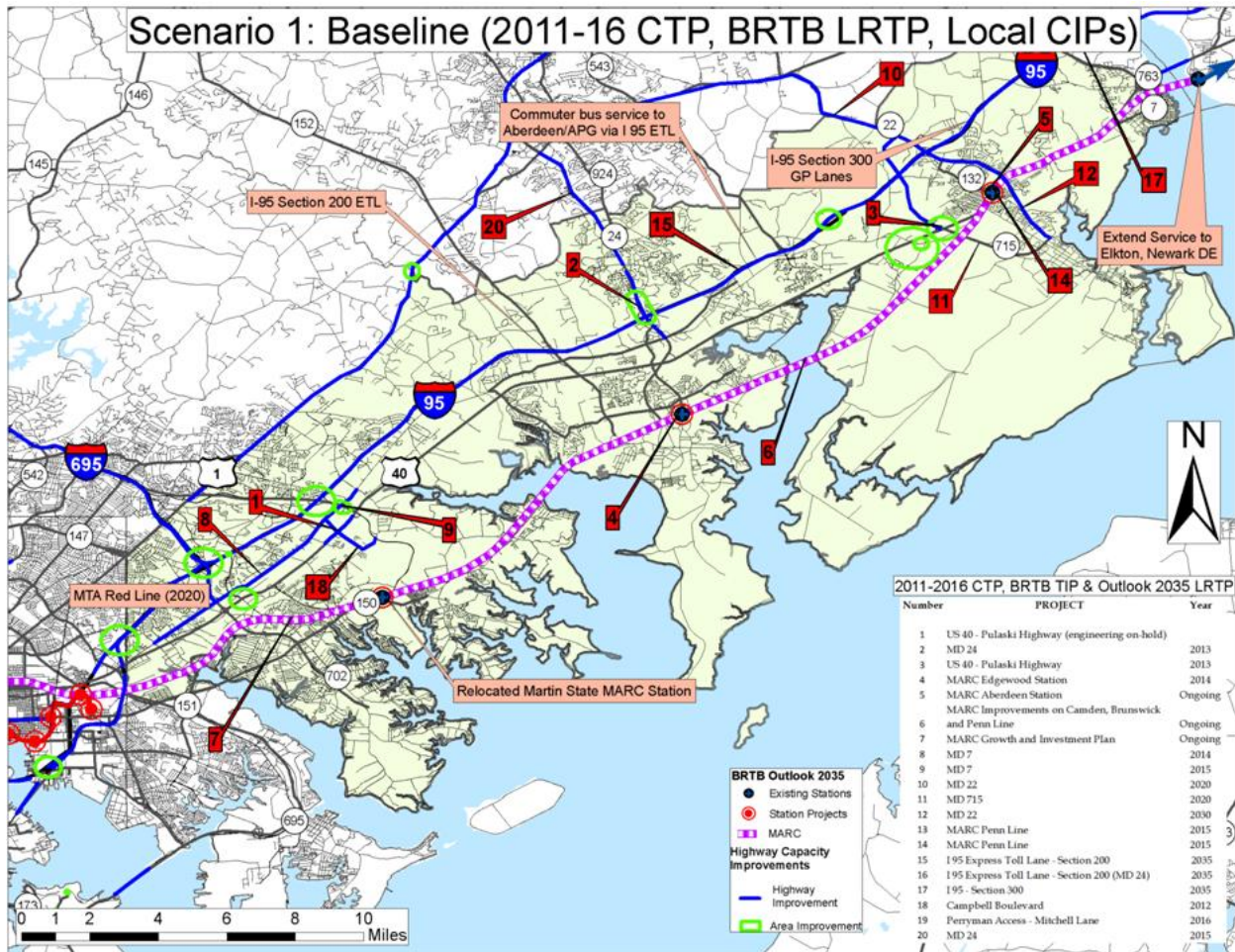


IV. US 40 Corridor Trends Presentation GHG Emissions – Non Transportation

MMTCO ₂ E	2006	2050	2006-2050
Total IP and Other (excluding sinks)	0.39	0.51	30%
Industrial Processes	0.16	0.20	22%
Cement Manufacture	0.03	0.03	
Iron & Steel Manufacture	0.02	0.02	
ODS Substitutes	0.09	0.13	
Electricity Transmission & Dist.	0.01	0.01	
Aluminum Production	0.01	0.01	
Agriculture	0.02	0.02	0%
Enteric Fermentation	0.003	0.003	
Manure Management	0.003	0.003	
Ag Soils	0.01	0.01	
Ag Residue Burning	0.0001	0.0001	
Waste Management	0.21	0.29	38%
Municipal Wastewater	0.02	0.03	
Solid Waste	0.19	0.27	
Emission Sinks	(0.30)	(0.30)	0%

G. Scenario 1 - 4 Descriptions

Scenario 1 – 2035 Baseline:

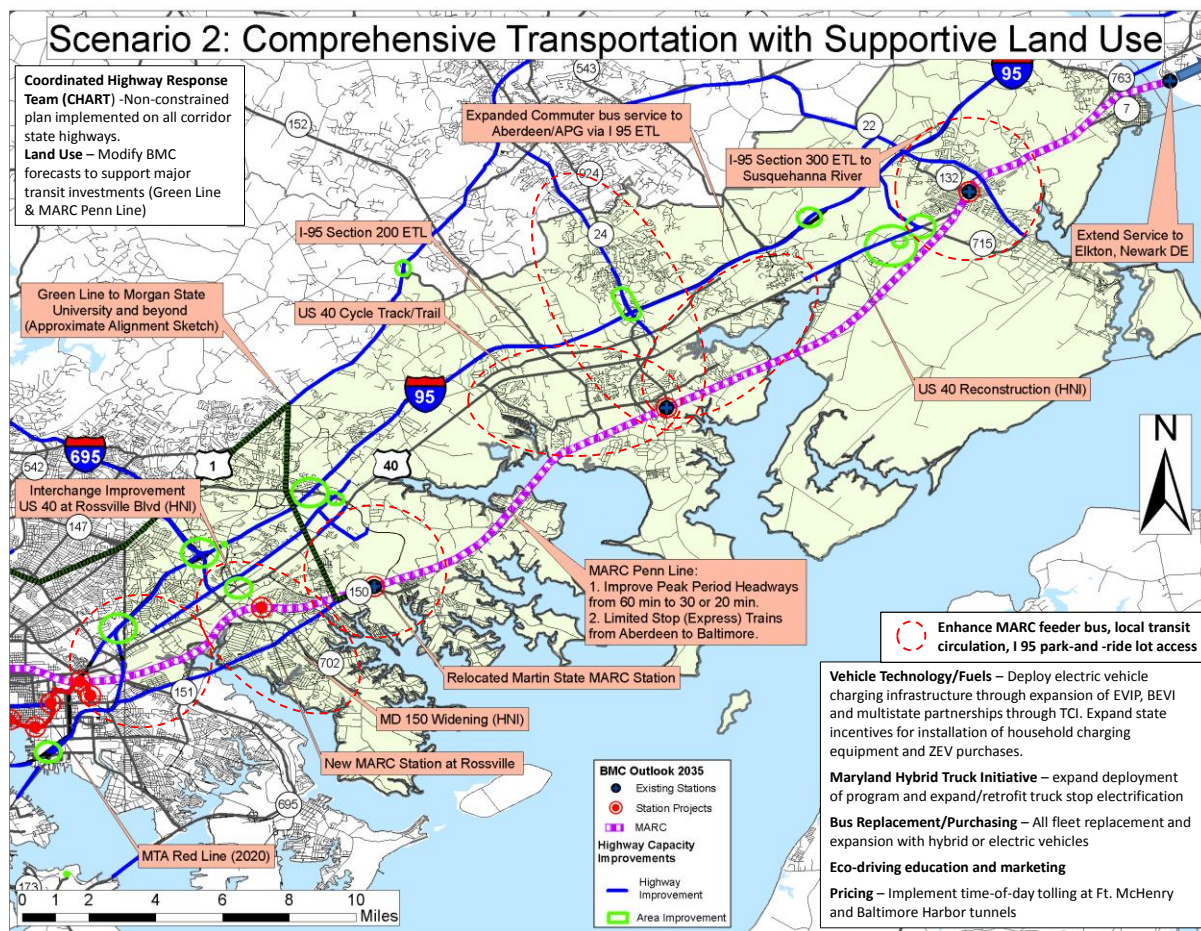


Transportation, land use, conservation and energy consumption consistent with existing programs and funded future actions.

- Population and employment growth through 2035 consistent with BRTBs round 7C cooperative forecast (2010)
- Transportation investment through 2035 as funded and programmed within the FY 2011-FY 2016 CTP, BRTB 2010-2014 TIP, and BRTB Outlook 2035 LRTP
- Energy consumption from other sectors representing a corridor specific subset of the State forecast GHG emissions in the 2008 Climate Action Plan



Scenario 2 – Transportation Activity, Efficiency and Emissions:



Transportation infrastructure, programs, policies, and system and vehicle technology focused scenario with supportive land use.

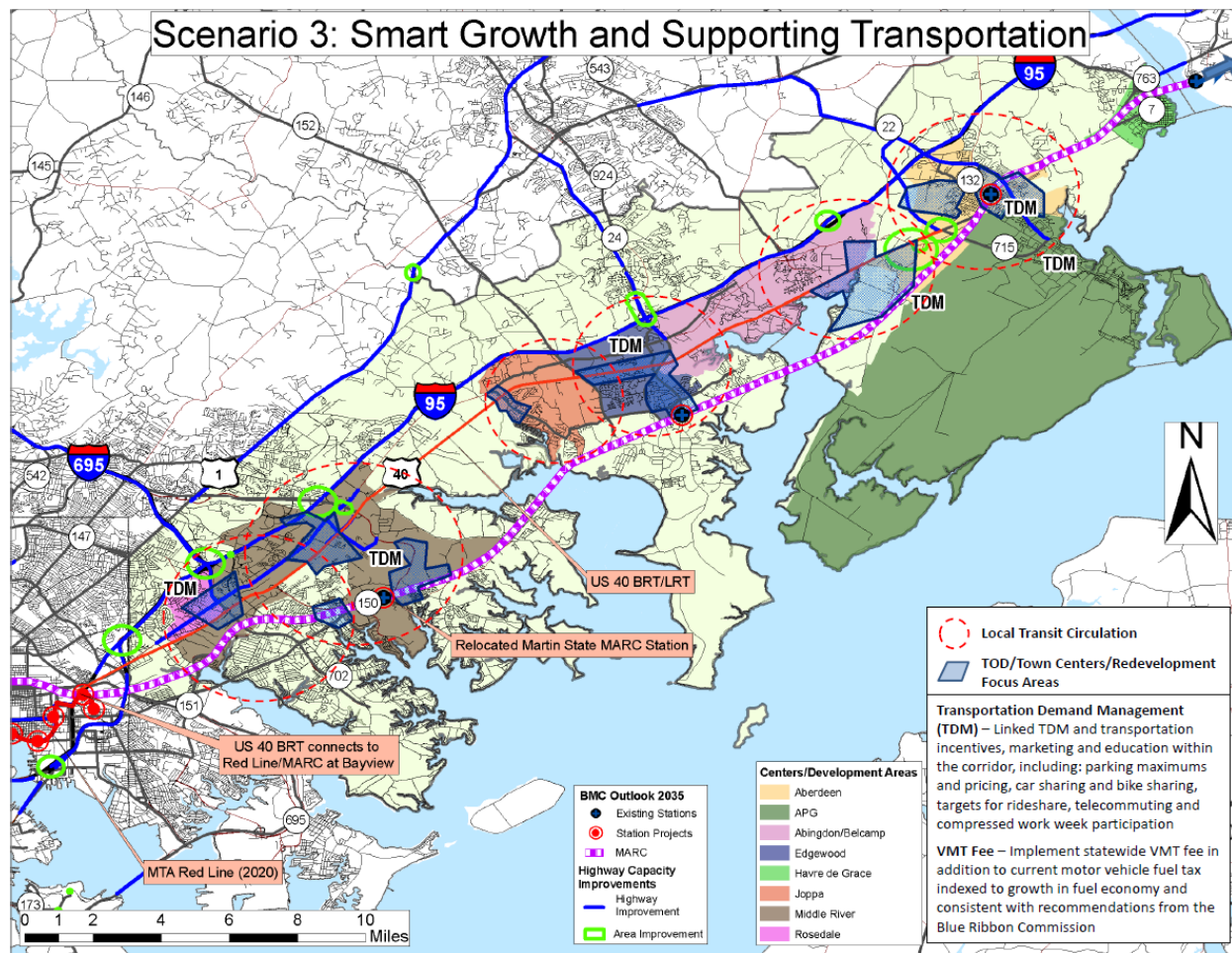
- Implement recommendations of Baltimore Regional Rail Plan (Red Line, Green Line)
- Accelerate strategic implementation of the MARC Growth and Investment Plan
- Complete I-95 Section 200 & Section 300
- Statewide Trails Plan - US 40 cycletrack from Aberdeen to Bayview
- Comprehensive pedestrian and bicycle improvements to access transit
- CHART (Coordinated Highway Action Response Team) Non-Constrained Deployment Plan
- BRAC Public Transportation Plan (Expand commuter bus on I-95, and local circulation)
- Consolidate technology outcomes of Electric Vehicle Infrastructure Program (EVIP), Baltimore Electric Vehicle Initiative (BEVI), and Transportation and Climate Initiative (TCI)
- Low carbon/energy efficient capital investments - Signal synchronization, traveler information, truck stop electrification, traffic flow enhancements (CHART)



- Implement cordon charge/parking pricing in Baltimore CBD
- Maximum Transit Oriented Development at Green Line and MARC Penn Line Stations



Scenario 3 – Land Use and Development:



Smart growth and development focused scenario with supportive transportation and land conservation strategies.

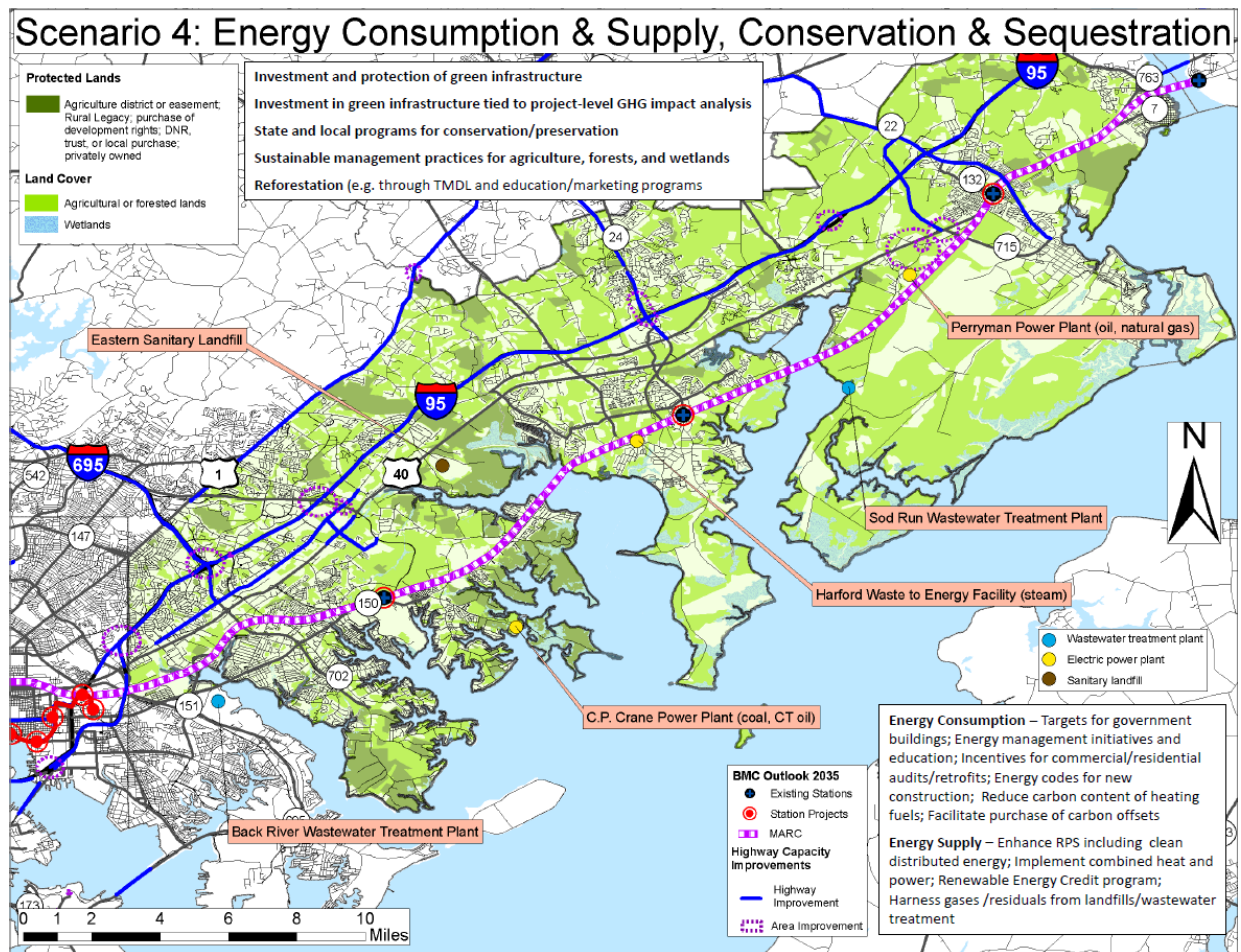
- Focus corridor population and employment growth in activity centers and adjacent to transit stations. Development will incorporate smart growth strategies, multi-family/mixed income housing, and site design measures to encourage transit use, increase bike and pedestrian trips, and to overall minimize VMT per capita. The activity centers include:
 - Rossville
 - White Marsh
 - Middle River
 - Joppatowne
 - Edgewood
 - Abingdon/Perryman



- Aberdeen/APG
- Havre de Grace
- Implement bus rapid transit or light rail service on the US 40 corridor from Bayview MARC/Red Line station to Aberdeen
- Develop an interconnected local transit and bike and pedestrian system connecting existing and new corridor residential developments to US 40 BRT/LRT, employment along US 40 and surrounding the White Marsh area, new or expanding nodes in town centers, and APG
- Deploy consistent and linked travel demand management (TDM) and transportation marketing/education programs implemented in the corridor
- Implement a statewide VMT fee in addition to existing motor vehicle fuel taxes



Scenario 4 – Consumption, Conservation, and Sequestration:



Multi-sector energy consumption and supply focused scenario with conservation and carbon sequestration strategies.

- A series of mandates, incentives, and challenges marketed and partially sponsored through EmPOWER Maryland, to spur the reduction of energy consumption in government, residential, commercial, and industrial sectors and to increase the share of energy supply through renewable sources
 - Consumption Strategies:
 - » Expand energy management initiatives by supporting smart metering and real-time pricing technologies for residents and businesses, with particular emphasis on reducing peak loads
 - » Promote energy-efficient commercial buildings and residences through the continuation and establishment of new incentives and regulations/standards
 - » Increase the proportion of ENERGY STAR compliant buildings through tax incentives, corporate/institutional partnerships, government building adoption,



- low-interest loans/loan underwriting, grants, conditional density bonuses, and strengthening energy and building codes
- » Reduce the carbon content of heating fuels by incentivizing (loans, grants, rebates) or mandating (building codes) the installation of cleaner burning boilers, furnaces, and hot water heaters
- » Create a statewide or regional energy efficiency authority to coordinate integrated energy management programs, including public education programs, education programs for business owners, and other outreach activities
- Supply Strategies:
 - » Enhance the Statewide Renewable Portfolio Standard (RPS) to require increasingly greater representation of alternative energy sources, including clean Distributed Generation
 - » Enhance solar and geothermal grant programs
 - » Provide financial and regulatory support for the expansion of natural gas infrastructure, with the expectation of displacing more carbon-intensive heating fuels
 - » Harness digester gases (principally methane) from municipal solid waste (landfills) and wastewater treatment (sewage treatment plants) to produce energy
- Aggressive expansion of the scope of policies and programs consistent with the State Green Infrastructure Plan, local policies for agricultural land and natural resource preservation, more stringent policies and new best management practices for protecting areas with high sequestration potential, and continuation/expansion of programs that will also sequester carbon consistent with meeting targets of the Chesapeake Bay TMDL, Watershed Implementation Plan



H. Base, Baseline, and Scenario 2 - 4 Results

US 40 CNC Scenario Tests - Performance Measures						
Performance Measures		2006 Base	Scenario 1 2035	Scenario 2 2035	Scenario 3 2035	Scenario 4 2035
Land Use & Development						
	Corridor socioeconomic data & forecasts					
1	Corridor total population	256,837	332,122	381,452	378,568	See Scenario 1 Results
2	Corridor total households	99,346	134,962	164,284	163,221	
3	Corridor total employment	118,129	190,750	225,801	219,549	
4	Retail	24,977	36,584	47,297	40,619	
5	Office	46,338	76,416	89,481	91,716	
6	Industrial	13,674	22,147	24,599	25,079	
7	Other	33,140	55,603	64,424	62,135	
Priority Funding Area (PFA)						
8	Share of corridor population in PFA	94.4%	93.9%	94.7%	94.6%	
9	Share of corridor employment in PFA	96.4%	96.8%	97.3%	97.2%	
Town Centers						
10	Share of corridor population in town centers		19.1%			
11	Share of corridor employment in town centers		30.4%			
Share of population by density range						
12	Exurban/Rural (<500 ppsm)	9.3%	4.2%	3.6%	2.6%	
13	Low Density Suburban (< 2000 ppsm)	24.0%	22.5%	19.5%	22.8%	
14	High Density Suburban (< 4000 ppsm)	22.3%	31.3%	26.9%	22.8%	
15	Urban (< 10000 ppsm)	36.8%	37.2%	37.5%	39.4%	
16	Center	7.6%	4.8%	12.6%	12.3%	
Conservation & Restoration						
	Corridor Share of Land Use/Land Cover					
17	Agriculture	11.4%	8.7%	8.7%	10.3%	10.9%
18	Forests/pastures/brush	39.4%	28.0%	28.0%	34.7%	37.1%
19	Wetlands	7.6%	7.6%	7.6%	7.6%	7.6%
20	Urban - Undeveloped	1.9%	0.2%	0.2%	0.2%	0.2%
21	Developed - Residential	18.0%	32.0%	32.0%	23.7%	20.6%
22	Developed - Non-Residential	21.7%	23.6%	23.6%	23.6%	23.6%



US 40 CNC Scenario Tests - Performance Measures							
Performance Measures		2006 Base	Scenario 1 2035	Scenario 2 2035	Scenario 3 2035	Scenario 4 2035	
Transportation - Mobile Sector Performance Measures (BMC Model output)							
Corridor daily person trips							
23	Total daily person trips	1,246,956	1,734,197	2,001,055	1,972,567	See Scenario 1 Results	
24	Total internal to corridor	804,834	1,163,194	1,370,212	1,375,886		
25	Total to/from Baltimore/Harford County	232,125	290,207	311,380	293,714		
26	Total to/from Baltimore City	139,740	156,717	175,676	165,265		
27	Total to/from region	31,739	49,483	57,996	52,442		
28	Total to/from I 95N	28,499	57,770	64,939	64,280		
29	Total to/from remainder of Maryland	10,019	16,826	20,852	20,980		
30	Person trip share inside corridor	64.5%	67.1%	68.5%	69.8%		
31	Person trip share leaving corridor	35.5%	32.9%	31.5%	30.2%		
Corridor daily transit trips							
32	Total	18,885	23,458	53,784	39,425	See Scenario 1 Results	
33	Home Based Work	14,121	17,405	38,579	30,639		
34	Home Based Other	2,677	3,617	8,141	4,891		
35	Non-Home Based	2,087	2,436	3,663	2,490		
36	School	1,166	1,207	3,401	1,405		
37	Home-based work transit mode share (all corridor trips)	5.5%	4.7%	8.5%	6.9%		
38	Home-based work transit mode share (internal corridor trips)	2.4%	1.8%	5.4%	4.1%		
39	Home-based work transit mode share (trips to/from Baltimore City)	12.4%	13.2%	19.7%	16.4%		
40	All trips transit mode share (all corridor trip ends)	1.2%	1.1%	2.3%	1.7%		
Corridor daily VMT (1000s)							
41	All	6,461.8	10,067.1	10,555.0	10,173.0	See Scenario 1 Results	
42	Auto	4,736.9	6,968.2	7,521.9	7,048.1		
43	Truck	845.9	1,336.5	1,339.1	1,359.8		
44	External	879.0	1,772.3	1,694.0	1,765.1		
45	Average Home Based Work Trip Length	12.2	10.6				
46	Daily VMT per household	47.7	51.6	45.8	43.2		
47	Daily transit trips per household	0.2	0.2	0.3	0.2		
Corridor share of VMT by LOS (PM peak period)							
48	LOS A-B	16.6%	7.4%	8.1%	8.1%		
49	LOS C-D	53.3%	36.7%	39.8%	38.5%		
50	LOS E	28.9%	53.0%	45.2%	50.5%		
51	LOS F	1.2%	2.8%	6.9%	2.9%		
Transportation Sector Daily VMT (1000s) Reductions (Additional Off-model Strategies)							
52	US 40 cycletrack with connecting on-street town center and corridor wide bike network	-	-	98.2	-	-	
53	US 40 corridor comprehensive pedestrian improvements (schools, activity centers, transit station access)	-	-	172.0	242.2	-	
54	Employer based commute programs (Aberdeen, Edgewood/Perryman, White Marsh/Middle River, Rosedale/Rossville)	-	-	-	427.7	-	
55	Employer Based Commute Programs (Aberdeen Proving Ground)	-	-	-	169.2	-	
Transportation Sector Daily Hours of Delay Reductions (Additional Off-model Strategies)							
56	Expanded deployment of CHART (all principal arterials)	-	-	11,322	-	-	
57	Corridor signal synchronization, intelligent transportation systems (ITS), traveler information	-	-	9,535	-	-	



US 40 CNC Scenario Tests - GHG Emissions						
GHG Emissions (mmt CO2e)		2006 Base	Scenario 1 2035	Scenario 2 2035	Scenario 3 2035	Scenario 4 2035
Transportation Sector Annual Emissions (mmt CO2e)						
ON-ROAD MOBILE EMISSIONS						
1	Existing National Programs (see Appendix L, Table L.18)	1.57	1.77	1.83	1.79	1.77
Proposed Vehicle Technology Programs						
2	Maryland Clean Car /National Fuel Economy Standards (2017-2025)	-	(0.46)	(0.48)	(0.46)	(0.46)
3	Medium/Heavy Duty Truck Standards (2014-2018)	-	-	(0.25)	-	-
Extend LDV programs at constant growth rate through 2035						
Transportation Fuel Programs						
4	Renewable Fuels Standard (EPA RFS2)	-	(0.04)	(0.04)	(0.04)	(0.04)
5	Low Carbon Fuels Standard	-	(0.18)	(0.18)	(0.18)	(0.18)
Additional Vehicle Technology Strategies						
6	Electric vehicle infrastructure and purchasing incentives	-	-	(0.04)	-	-
7	Hybrid/electric bus purchases	-	-	(0.00)	-	-
8	Hybrid truck initiative and truck stop electrification	-	-	(0.00)	-	-
9	Additional Off-Model Transportation Strategy GHG Reductions	-	-	(0.07)	(0.06)	-
10	Annual GHG Emissions (tons) per Household	15.80	8.11	4.75	6.43	8.11
OFF-ROAD MOBILE EMISSIONS						
11	Freight & Commuter Rail	0.09	0.11	0.11	0.11	0.11
12	Other Off-Road	0.27	0.33	0.33	0.33	0.33
13	TOTAL MOBILE EMISSIONS	1.92	1.53	1.22	1.48	1.53
All Other Sector Annual Emissions (mmt CO2e) (See Appendix L, Table L.17 for more detail)						
ELECTRICITY CONSUMPTION						
14	Residential	0.74	0.95	1.15	1.10	0.34
15	Commercial	0.62	0.92	1.11	1.07	0.21
16	Industrial	0.12	0.19	0.21	0.21	0.15
FUEL CONSUMPTION						
17	Residential	0.30	0.39	0.47	0.45	0.26
18	Commercial	0.17	0.25	0.30	0.29	0.16
19	Industrial	0.24	0.35	0.39	0.36	0.32
20	FOSSIL FUEL INDUSTRY	0.03	0.06	0.06	0.06	0.06
21	INDUSTRIAL PROCESSES	0.16	0.19	0.19	0.19	0.15
22	AGRICULTURE	0.02	0.02	0.02	0.02	0.02
WASTE MANAGEMENT						
23	Municipal Wastewater	0.02	0.02	0.02	0.02	0.02
24	Solid Waste	0.19	0.24	0.24	0.24	0.07
25	TOTAL ALL OTHER SECTOR EMISSIONS	2.61	3.57	4.16	4.01	1.75
26	Annual GHG emissions (tons) per household	10.46	9.89	9.89	9.49	4.43
27	Annual GHG emissions (tons) per commercial job	7.52	6.93	6.93	6.93	2.23
28	Annual GHG emissions (tons) per industrial job	26.53	24.40	24.40	24.40	21.04
Total Annual Multi-Sector Corridor Emissions (mmt CO2e)						
29	TOTAL MULTI-SECTOR EMISSIONS	4.54	5.10	5.38	5.49	3.28
Total Corridor Annual Carbon Sequestration (mmt CO2e) (See Appendix L, Table L.17 for more detail)						
30	EMISSION SINKS - TOTAL FOREST CARBON SEQUESTRATION	(0.30)	(0.24)	(0.24)	(0.27)	(0.29)
Conservation & Restoration Strategies						
31	Intensive Forest Management					(0.01)
32	Urban Tree Canopy					(0.12)
33	Agricultural Lands Preservation					(0.07)
34	Aforestation (excluding APG)					(0.00)
35	Reforestation - Riparian Buffers (excluding APG)					(0.00)
36	TOTAL CONSERVATION & RESTORATION STRATEGIES	-	-	-	-	(0.21)
Total Net Annual Corridor Emissions (mmt CO2e)						
37	TOTAL NET CORRIDOR EMISSIONS (mmt CO2e)	4.24	4.86	5.14	5.22	2.99
Total Net Annual Corridor Emissions per Household (tons CO2e)						
38	Annual GHG Emissions per Household (Transportation Sector - On-Road)	15.80	8.11	4.75	6.43	8.11
39	Annual GHG Emissions per Household (Residential Sector)	10.46	9.89	9.89	9.49	4.43
40	Annual GHG Emissions per Household (TOTAL)	26.26	18.00	14.64	15.92	12.55
Percent Change From 2006 Corridor GHG Emissions						
41	Total Corridor Transportation Sector GHG Emissions		-20%	37%	23%	20%
42	Total Corridor Other Sector GHG Emissions		36%	-59%	-53%	33%
43	Total Corridor Multi-Sector GHG Emissions		12%	19%	21%	-39%
44	Total Corridor Net Multi-Sector GHG Emissions		15%	21%	23%	-29%



GHG Emissions & Methodology Data Source Documentation

Baltimore Regional Transportation Board:

- Transportation Improvement Program – FY 2012 – FY 2015
www.baltometro.org/transportation-planning/transportation-improvement-program-2012-2015
- Outlook 2035 Long-Range Transportation Plan
www.baltometro.org/content/view/566/401/
- Round 7C Cooperative Forecasts (2010)
- Baltimore Regional Travel Demand Model, Version 3.3.e (2006)
www.baltometro.org/content/view/361/282/

MDE:

- Maryland Climate Action Plan - Greenhouse Gas & Carbon Mitigation Working Group Policy Option Documents (Appendix D) –
 - Forest Management for Enhanced Carbon Sequestration (pg.5)
 - Managing Urban Trees and Forests for GHG Benefits (pg. 13)
 - Afforestation, Reforestation, and Restoration of Forests and Wetlands (pg. 21)www.mde.state.md.us/assets/document/air/climatechange/appendix_d_mitigation
- Maryland Climate Action Plan – Inventory and Forecast (Appendix C)
www.mde.state.md.us/assets/document/Air/ClimateChange/AppendixC_Inventory

MEA:

- EmPOWER Maryland <http://energy.maryland.gov/facts/empower.html>

MDOT:

- 2011 MDOT Climate Action Plan and Appendix
http://www.mdot.maryland.gov/Planning/Environmental_Planning.html

US EPA:

- Landfill Gas Feasibility www.epa.gov/lmop/basic-info/index.html
- Wastewater Treatment www.epa.gov/lmop/basic-info/index.html

US DOE:

- Energy Information Administration, *Annual Energy Outlook 2011*, Table 7 – Transportation Sector Key Indicators and Delivered Energy Consumption
http://www.eia.gov/forecasts/aeo/sector_transportation.cfm

Miscellaneous Sources:

- Eastern Sanitary Landfill Gas to Energy plant www.pepcoenergy.com/Pages/PP-EasternSanitaryLandfill.aspx



- Combined Heat and Power, Industrial Sector – Appalachian Regional Commission
www.arc.gov/assets/research_reports/EnergyEfficiencyChapter5.pdf
- City of Baltimore, Back River Waste Water Treatment Plant
www.baltimorecity.gov/Government/AgenciesDepartments/GeneralServices/NewsArticles/tabid/1018/articleType/ArticleView/articleId/706/Converting-Wastewater-Biogas-into-Renewable-Energy.aspx
- Environment America. *Building Better: How High-Efficiency Buildings Will Save Money and Reduce Global Warming*. 2010
<http://www.environmentamerica.org/uploads/d6/09/d6098e7f9dacc59129a776f81df87caf/Building-Better-vAME.pdf>
- U.S. Department of Energy's (DOE) Commercial Building Energy Alliances (CBEAs)
http://www1.eere.energy.gov/buildings/commercial_initiative/publications.html



I. Stakeholder Interviews

Process Overview

- Stakeholder's were identified for interviews to meet the following objectives:
 - Ensure a diverse background of corridor activities and interests are represented (large and small businesses, residents, environment, political, government)
 - Ensure that the U.S. 40 CNC plan process appropriately reflected concerns of those who live and work along the corridor
- Invitation letter included a project overview, with benefits of the carbon neutral corridor concept and summary descriptions of the four scenarios
- Followed up via email and telephone to secure interview appointment

Name	Affiliation	Jurisdiction	Position
Gayle Adams	Essex-Middle River-White Marsh Chamber of Commerce	Baltimore	President (also represents Johns Hopkins Bayview Medical Center)
Bob Bendler	Essex-Middle River Civic Council	Baltimore	President/ Board Member
Ralph Cardenuto	Aberdeen Proving Ground	APG	U.S. Army APG Garrison
Sharon Daboin	CSX Transportation	Regional	Resident VP, State Government and Community Affairs
Vanessa Milio	Harford County Chamber of Commerce	Harford	President
Brian O'Malley	Central Maryland Transportation Alliance	Baltimore	Director of Transportation Policy and Research
John Quinn	Constellation Energy Group	Regional	Director of Environmental Issues
Jansen Robinson	Edgewood Community Council	Harford	Chair
Eric Slechter	Franklin Square Hospital Center	Baltimore	Director of Planning
William Tiger	GM White Marsh – Allison Transmission	Baltimore	Plant Manager
Janice Washington*	Aide to State Delegate Burns (Baltimore County, District 10)	Baltimore	Aide to State Delegate
Kathy Szeliga	District 7 State Delegate	Baltimore/Harford	State Delegate
Phyllis Grover	City of Aberdeen	Aberdeen	Director of Planning



Interview Questions

Questions were designed to foster discussion and obtain insights on the current challenges facing the corridor and areas of opportunity.

- What current programs does your business or organization currently promote that are consistent with the carbon neutral corridor concept?
- Based on what has been presented from the Scenarios to date, are the approaches feasible; are there significant barriers (technical, environmental, regulatory, political) to implementation that we should consider?
- What particular concerns and/or interests do you have? Are they represented in the scenario planning process? Why or why not?
- What do you think of the carbon neutral concept overall? Is this something you would see yourself championing? Why or why not?

Stakeholder Feedback

Stakeholders provided valuable feedback. Some specific comments include:

“As new communities are developed, find a way to encourage energy efficient homes, use of mass transit or carpooling... Promote and encourage communities to reduce demand on utilities and commuting.” (William Tiger, GM White Marsh Plant)

“I am absolutely in favor of the carbon neutral concept. Our organization made the decision to become a green power leader in Maryland.” (John Quinn, Constellation Energy)

“I would look at low impact development best practices to keep water on site to reach large aquifers, as the presence of aquifers has decreased by ½ since 1960. Here at APG, we keep that in mind for all of our projects.” (Ralph Cardenuto, APG)

“If you talk to builders and developers, they will tell you that they are concerned about how long it takes to get the licenses and permits they need. So if you are developing specific land uses or development projects, the ability to permit and encourage them is very important.” (Gayle Adams, EMRWM Chamber of Commerce)

“More support from state agencies for designated TODs - planning support and funding support so ideas can become a reality. They have the expertise and knowledge to assist local jurisdictions and make these become a reality.” (Phyllis Grover, City of Aberdeen)

“Green residences and business are important. Incentives to be green can be a selling point for attracting new business and residences to the community.” (Jansen Robinson, Edgewood Community Council)

General outcomes of the stakeholder interviews:

- All stakeholders expressed interest in the concept and desire for continuing involvement
- Stakeholders focused on the elements of the concept helping to continue economic growth and increasing the attractiveness of the corridor



- Stakeholders connected with the business community, provided a perspective that the corridor has been "under represented or supported" by state programs, particularly transportation
- Most also noted that businesses and residents in the corridor are highly supportive of more transportation options
- Incentives or support/educational programs are preferred over fees or taxes, particularly for transportation related strategies
- Other key corridor stakeholders were identified, particularly local business owners active in organizations
- Constellation Energy and GM White Marsh identified the opportunity for partnerships particularly with regard to electric vehicle charging infrastructure
- A group of questions/comments from the stakeholders was repeated across all the interviews
 - How are these ideas implemented?
 - Who is responsible?
 - What is my potential role?
 - How is it funded?

J. Scenario 5 Description

US 40 Carbon Neutral Corridor – Scenario 5

Scenario Component	2010 - 2035 Description
MULTIMODAL & ENERGY EFFICIENT TRANSPORTATION	
MARC Penn Line - MARC Growth and Investment Plan	15-minute (peak direction) / 40-minute (off-peak direction) headways (level-of-service assumes build-out of MARC Growth and Investment Plan including storage/maintenance yard, parallel tracks, reconstructed bridges) Hourly service in off-peak (both directions) Optional new station with PNR lot at Rossville Blvd. (did not evaluate new station within Scenario 5 assessment)
US 40 Bus Rapid Transit Corridor	US 40 from MARC / MTA Red Line Bayview Station to Aberdeen MARC Station 5-minute headway in peak-period (both directions), 20-minute headway in off-peak period (both directions) Stops at 0.5 to 1 mile spacing and all major intersections Operates in exclusive lanes or shoulders with transit signal priority, All BRT vehicles to be electric/hybrid Enhanced stops with real-time passenger information
Local Bus/Circulator Systems	Operating on 10 minute headways circulating both-directions in the following town centers: Havre de Grace/Aberdeen, Edgewood/Joppatowne, White Marsh/Middle River, Rossville/Rosedale Routes will connect to MARC Stations, US 40 BRT stations, I-95 PNR lots, and corridor town center development All local/circulator buses to be electric/hybrid Routes will link to existing Harford County Transit and MTA local bus routes
MTA Commuter Buses	MTA 420 realignment from US 40 to I-95 ETL (Havre de Grace - Aberdeen MARC - MD 543 PNR - White Marsh - Baltimore) MTA 120, 410, 411, and 412 operating on I-95 ETL with same frequency as coded in BRTB Outlook 2035 LRTP
I-95 Section 200 (MD 43 - MD 22)	2 ETLs and 4 GPLs from MD 43 to north of MD 543. 4 GPLs from MD 543 to project limits north of MD 22. Consistent with BRTB transportation network modeling in BRTB Outlook 2035 LRTP, I-95 ETLs operate at \$0.15/mile to maintain LOS C/D conditions.
CNC - Smart Corridors (US 40 - Havre de Grace to Bayview, MD 43 - US 1 to MD 150, MD 150 - US 40 to Martin State, MD 24 - Bel Air to Edgewood, MD 22 - APG Gate to I-95)	Implement consolidated real-time traffic management including: bus signal priority, adaptive traffic management and signal coordination, traveler information, incident management,
Off-Road trails / US 40 Cycletrack	US 40 cycletrack (parallel off-road or buffer-separated path on US 40) from Bayview to Havre de Grace - within US 40 ROW or on parallel facilities Implement planned trails/bikeways/greenways in BRTB Outlook 2035 LRTP and Baltimore and Harford County Master Plans

Scenario Component	2010 - 2035 Description
On-Road Bike Network	<p>Corridor signed bike routes - provides directions to MARC stations, US 40 corridor, town centers, off-road bike facilities, schools and civic facilities</p> <p>Bike lanes and shared lane markings on collectors and minor arterials, maintaining a density of a 2 mile of on-road facilities per 1 square mile of developed area. Direct access to all MARC stations.</p> <p>Protected bike parking (lockers) at all MARC stations and PNR lot locations</p>
Pedestrian Network	<p>Buffered sidewalks on US 40 in all developed areas with full street crossing amenities (Boulevard treatment for US 40 from Bayview MARC Station to Ebenezer Road, Joppa Farm Road to MD 24, Riverside Parkway to MD 22)</p> <p>Sidewalks on all streets crossing US 40 and parallel local streets developed as part of a new street grid within town centers</p> <p>Sidewalks in all town center areas and access to MARC stations and all local transit stops</p>
Transportation Demand Management	<p>Harford County: Implement comprehensive and consistent TDM programs (ridesharing, guaranteed ride home, vanpool incentives) at the Gate at APG, Northgate, Waters Edge, and emerging business / technology / warehousing parks in Aberdeen, Perryman, and Edgewood. Set telecommute and compressed work week participation targets and implement zoning overlays identifying parking maximums, transit access, and bike/pedestrian amenities requirements.</p> <p>Baltimore County: Implement comprehensive and consistent TDM programs (ridesharing, guaranteed ride home, vanpool incentives) for existing and new major employers in the White Marsh/Middle River area. Set telecommute and compressed work week targets and implement zoning overlays identifying parking maximums, transit access, and bike/pedestrian requirements. Include existing/expanded programs at GM/Allison Transmission Plant, White Marsh Mall, Franklin Square Hospital Center, and the Community College of Baltimore County.</p>
Incentives for Auxiliary Power Units (APUs) and Truck Stop Electrification (travel plazas, private truck stop facilities)	<p>Incentive programs for purchasing and commercial use of APUs. Expanded availability of TSE at Travel Plazas and truck stops.</p>
Commercial Vehicle Fleet Renewal (hybrid/electric)	<p>Focus on light/medium duty commercial vehicles (delivery trucks, service vehicles). Assume increasing share of corridor based single unit truck VMT is fully electric.</p> <p>To support increased share of light and medium commercial electric vehicle VMT, implement incentive based program supporting deployment of vehicle charging infrastructure for commercial fleet vehicles</p>
Agency Vehicle Fleet Renewal (hybrid/electric)	<p>Buses (transit and school), garbage trucks, all agency fleet vehicles – Assume broad deployment of electric vehicle infrastructure for public fleets, diesel-hybrid vehicles, or low carbon fuel vehicles</p>
Private Vehicle Charging Infrastructure	<p>Public deployment - travel plazas, park-and-ride lots, government facilities, schools</p> <p>Private deployment - incentives for household purchase and installation. Assume that 15 percent of corridor VMT in 2035 are electric vehicles. Connect impacts of broad deployment of residential vehicle charging units on household energy consumption and supply. There are multiple considerations regarding the design and capacity of the electrical grid for supporting widespread household based electric vehicle charging.</p>

Scenario Component	2010 - 2035 Description							
LOW CARBON LAND USE & DEVELOPMENT								
<i>Scenario 5</i> – Reorient corridor growth through 2035 to maximize opportunities to conserve and protect agricultural and natural lands, including riparian buffers, watersheds, forests, and wetlands. Minimize proportion of corridor growth occurring outside PFA boundary and town center areas (reorient 90% of residential and commercial growth outside PFAs and 75% of growth outside town centers to the corridor town centers). Total corridor growth remains constant with the current BMC 2035 forecast.								
<i>Optional Scenario 5B – Reorient Growth + Town Center New Growth:</i> Reorient growth as described above plus add new corridor households (22,000 new households in town centers) and employment (25,000 new jobs in town centers). The level of new growth is based on an assessment of development capacity in these locations, not constrained by existing zoning guidelines, with higher densities including a significant share of multi-family and single-family attached housing (70% or greater). Development occurs on a combination of vacant urban land, infill residential on current low density residential land and near transit stations, new commercial in underutilized/older light industrial parcels and limited development on agricultural parcels in Perryman. This scenario option ultimately was not selected by the Interagency Steering Committee for further analysis.								
The table below presents the summary of the 2035 Baseline, Scenario 5A, and Scenario 5B socioeconomic data totals in the corridor.								
US 40 CNC - Baseline and Scenario 5 Socioeconomic Data Summary								
	Corridor Total				Town Centers Total			
	Population	Households	Workers	Employment	Population	Households	Workers	Employment
Baseline	332,122	134,962	160,212	190,750	63,517	26,286	30,084	57,941
Scenario 5	332,122	134,962	160,212	190,750	97,924	40,590	46,455	63,874
Scenario 5B	365,522	156,756	188,625	216,529	131,324	62,384	74,868	89,653
Baltimore County Town Centers		Assume share of new households (70% MF, 20% SF attached, 10% SF) with opportunities for lower income housing. Assume 75% of new households through 2035 are LEED platinum/meet corridor goals to reduce energy consumption per household. Assume all MF/SF attached development include public electric vehicle charging accommodating 25% of residents.						
	Rosedale/Rossville	20 units per acre multi-family on urban vacant areas, 30+ units per acre adjacent to planned Rossville MARC Station, assume infill development in lower density residential areas (single-family attached), assume new households at 1.8 persons per hh (consistent with TOD in Baltimore). Focus new commercial/office employment growth at US 40/Rossville Blvd. center and adjacent to Franklin Square Hospital Center / Baltimore County Community College.						
	White Marsh	20 units per acre multi-family on urban vacant areas, assume infill development in lower density residential areas, assume new households at 1.8 persons per hh (consistent with TOD in Baltimore). Focus employment growth adjacent to White Marsh mall, reuse of older light industrial parcels on US 40 with office and mixed-used commercial/residential development.						
	Middle River/Martin State	20 units per acre multi-family on urban vacant areas, 30+ units per acre adjacent to Martin State MARC Station, assume infill development in lower density residential areas, assume new households at 1.8 persons per hh (consistent with TOD in Baltimore).						
Harford County Town Centers		Assume share of new households (40% MF, 40% SF attached, 20% SF) with opportunities for lower income housing. Assume 75% of new households through 2035 are LEED platinum/meet corridor goals to reduce energy consumption per household. Assume all MF/SF attached development include public electric vehicle charging to accommodate 25% of residents.						
	Joppatowne	Average density of 4 units per acre based on development of rural residential and new infill single family attached and multifamily development on US 40.						

Scenario Component	2010 - 2035 Description
Edgewood	Average density of 10 units per acre based on development of underutilized parcels and new infill multi-family on US 40 and adjacent to MARC station.
Riverside/Perryman	Average density of 7 units per acre based on development of agriculture and agriculture residential land uses. Mix of housing types recommended.
Aberdeen	Average density of 12 housing units per residential acre, combination of infill multi-family development, single-family and single family-attached on low density and rural residential areas, increased commercial activity focused on US 40
Conservation and Protection Strategies	
Town Center Conservation Strategies	Strategically expand urban parks along off-road trails (greenways) and in green infrastructure gaps and corridors. Implement pilot programs/incentive programs for green roofs and urban tree planting.
Conservation and Protection strategies	To support reorientation of corridor growth to town centers, deploy extensive conservation and protection strategies aimed at maximizing protection of agricultural lands and natural areas.
Energy Consumption Strategies	
New construction	Make building code changes to include energy efficient design standards into all new building construction after 2020. All new buildings constructed after 2030 will produce the energy necessary to meet their consumption needs. Reduce energy consumption per square foot of floor space by 15 per cent by 2010, and 50 per cent by 2020 and 100% by 2035. Reduce per-unit-floor-area consumption of carbon-based electricity by 15 per cent by 2010, 50 per cent by 2020 and become 100 per cent carbon neutral by 2030 within all government owned and leased buildings.
Retrofit/weatherization	Basic energy retrofits and energy audits including replacing old technology and sealing leaks reduce energy consumption by 30% to a maximum of 50%. Assume that 80% to 100% (consider economically distressed households and their ability to retrofit their homes) of all existing buildings perform these basic retrofits given that they are very cost effective.
Energy use management	20% of all homes and businesses in the corridor are equipped with computer based energy management systems for peak load recognition, task management and allocation to off-peak hours of electricity demand etc.
Appliances/lighting	50% of all households and commercial facilities replace their existing appliances and lighting systems with energy star rated technologies
ENERGY SUPPLY	
Renewable Portfolio Standard	20% Renewable Portfolio from Solar and other Tier 1 energy sources beyond 2022. Extrapolate to 2035 and assume that share of renewable energy is 35%.
Distributed Generation (Solar, Geothermal)	To offset the up-front costs of installing residential solar and geothermal systems, increase the existing grant percentage and caps for photovoltaic solar, for solar water heating, and for geothermal systems. 10% of all households and businesses install solar equipment for electricity and heating by 2035, and generate enough solar energy to offset their energy needs.
Residential/Commercial Fuels	Assume 5 percent of fuels used for household energy are now low carbon fuels (25 percent reduction in carbon content) and 2 - 4 percent of fuel use is converted to zero carbon energy sources (solar/geothermal)
Transportation Fuels	Based on EPA Renewable Fuels Standard, the use of renewable fuels will represent a 2 percent reduction in total mobile CO2 emissions by 2035. The regional low carbon fuel standard framework is under development, therefore performance targets have not been set. A 10 percent reduction in mobile CO2 emissions from low carbon fuels is assumed in 2035.

Example Town Center Redevelopment Concepts



Traditional downtown redevelopment

- Aberdeen
- Havre de Grace
- Middle River



Mall/town center redevelopment

- Rossville – Golden Ring Mall
- White Marsh - Mall/town center
- Aberdeen – MD 22/Beards Hill



US 40 – Nodal development

- Pulaski Corridor Redevelopment
- Joppatowne – Joppa Farm Rd.
- Edgewood
- Aberdeen – MD 715 to Downtown



Nodal development on minor arterials

- Edgewood Rd. @ Hanson Rd.
- Joppa Town Center



Residential – Higher density

- Adjacent to nodes and town centers
- 1/4 – 3/4 mi from node centers



Residential – Lower density

- 1/2-1 mile from node centers

RESTORATION AND SEQUESTRATION	
Management/Restoration Strategies	Expand and implement new forest, wetland, riparian buffer, and agricultural management and restoration programs to mitigate degradation of land and maximize carbon sequestration potential.
OTHER	
Industrial/Manufacturing	Work with partners to create pilot projects that reduce industrial energy consumption (per unit), through the expanded use of combined heat and power (CHP) through update regulations/standards, incentivize energy efficiency audits for industrial processes
Wastewater	Implement projects to harvest and generate usable energy from 25% of wastewater gas emissions (especially digester egg facilities), flare unused remainder
Landfills	Implement projects to harvest and generate usable energy from 25% of landfill gas emissions from modern sanitary landfills, producing approx. 800 kWh of electricity daily per 1 million tons of MSW. Flare remainder (transforms into CO ₂ , less potent GHG than CH ₄)



K. Scenario 5 Results

US 40 CNC Scenario Tests - Performance Measures							
Performance Measures		2006 Base	Scenario 1 2035	Scenario 2 2035	Scenario 3 2035	Scenario 4 2035	Scenario 5 2035
Land Use & Development							
	Corridor socioeconomic data & forecasts					See Scenario 1 Results	
1	Corridor total population	256,837	332,122	381,452	378,568		332,122
2	Corridor total households	99,346	134,962	164,284	163,221		134,962
3	Corridor total employment	118,129	190,750	225,801	219,549		190,750
4	Retail	24,977	36,584	47,297	40,619		36,584
5	Office	46,338	76,416	89,481	91,716		76,416
6	Industrial	13,674	22,147	24,599	25,079		22,147
7	Other	33,140	55,603	64,424	62,135		55,603
	Priority Funding Area (PFA)						
8	Share of corridor population in PFA	94.4%	93.9%	94.7%	94.6%		96.8%
9	Share of corridor employment in PFA	96.4%	96.8%	97.3%	97.2%		97.5%
	Town Centers						
10	Share of corridor population in town centers		19.1%				29.5%
11	Share of corridor employment in town centers		30.4%				33.5%
	Share of population by density range						
12	Exurban/Rural (<500 ppsm)	9.3%	4.2%	3.6%	2.6%		5.6%
13	Low Density Suburban (< 2000 ppsm)	24.0%	22.5%	19.5%	22.8%	20.2%	
14	High Density Suburban (< 4000 ppsm)	22.3%	31.3%	26.9%	22.8%	23.4%	
15	Urban (< 10000 ppsm)	36.8%	37.2%	37.5%	39.4%	40.9%	
16	Center	7.6%	4.8%	12.6%	12.3%	9.9%	
Conservation & Restoration							
	Corridor Share of Land Use/Land Cover						
17	Agriculture	11.4%	8.7%	8.7%	10.3%	10.9%	11.1%
18	Forests/pastures/brush	39.4%	28.0%	28.0%	34.7%	37.1%	37.9%
19	Wetlands	7.6%	7.6%	7.6%	7.6%	7.6%	7.6%
20	Urban - Undeveloped	1.9%	0.2%	0.2%	0.2%	0.2%	0.2%
21	Developed - Residential	18.0%	32.0%	32.0%	23.7%	20.6%	19.7%
22	Developed - Non-Residential	21.7%	23.6%	23.6%	23.6%	23.6%	23.6%



US 40 CNC Scenario Tests - Performance Measures							
Performance Measures		2006 Base	Scenario 1 2035	Scenario 2 2035	Scenario 3 2035	Scenario 4 2035	Scenario 5 2035
Transportation - Mobile Sector Performance Measures (BMC Model output)							
	Corridor daily person trips						
23	Total daily person trips	1,246,956	1,734,197	2,001,055	1,972,567		1,723,850
24	Total internal to corridor	804,834	1,163,194	1,370,212	1,375,886		1,158,858
25	Total to/from Baltimore/Harford County	232,125	290,207	311,380	293,714		287,392
26	Total to/from Baltimore City	139,740	156,717	175,676	165,265		152,875
27	Total to/from region	31,739	49,483	57,996	52,442		50,165
28	Total to/from I 95N	28,499	57,770	64,939	64,280		57,790
29	Total to/from remainder of Maryland	10,019	16,826	20,852	20,980		16,772
30	Person trip share inside corridor	64.5%	67.1%	68.5%	69.8%		67.2%
31	Person trip share leaving corridor	35.5%	32.9%	31.5%	30.2%		32.8%
	Corridor daily transit trips						
32	Total	18,885	23,458	53,784	39,425		30,984
33	Home Based Work	14,121	17,405	38,579	30,639		22,242
34	Home Based Other	2,677	3,617	8,141	4,891		4,840
35	Non-Home Based	2,087	2,436	3,663	2,490		1,655
36	School	1,166	1,207	3,401	1,405		2,247
37	Home-based work transit mode share (all corridor trips)	5.5%	4.7%	8.5%	6.9%	See Scenario 1 Results	6.0%
38	Home-based work transit mode share (internal corridor trips)	2.4%	1.8%	5.4%	4.1%		3.1%
39	Home-based work transit mode share (trips to/from Baltimore City)	12.4%	13.2%	19.7%	16.4%		15.2%
40	All trips transit mode share (all corridor trip ends)	1.2%	1.1%	2.3%	1.7%		1.5%
	Corridor daily VMT (1000s)						
41	All	6,461.8	10,067.1	10,555.0	10,173.0		9,983.5
42	Auto	4,736.9	6,958.2	7,521.9	7,048.1		6,877.3
43	Truck	845.9	1,336.5	1,339.1	1,359.8		1,333.1
44	External	879.0	1,772.3	1,694.0	1,765.1		1,773.1
45	Average Home Based Work Trip Length	12.2	10.6				11.0
46	Daily VMT per household	47.7	51.6	45.8	43.2		51.0
47	Daily transit trips per household	0.2	0.2	0.3	0.2		0.2
	Corridor share of VMT by LOS (PM peak period)						
48	LOS A-B	16.6%	7.4%	8.1%	8.1%		8.2%
49	LOS C-D	53.3%	36.7%	39.8%	38.5%		39.9%
50	LOS E	28.9%	53.0%	45.2%	50.5%		49.4%
51	LOS F	1.2%	2.8%	6.9%	2.9%		2.5%
Transportation Sector Daily VMT (1000s) Reductions (Additional Off-model Strategies)							
52	US 40 cycletrack with connecting on-street town center and corridor wide bike network	-	-	98.2	-	-	92.0
53	US 40 corridor comprehensive pedestrian improvements (schools, activity centers, transit station access)	-	-	172.0	242.2	-	141.7
54	Employer based commute programs (Aberdeen, Edgewood/Perryman, White Marsh/Middle River, Rosedale/Rossville)	-	-	-	427.7	-	125.0
55	Employer Based Commute Programs (Aberdeen Proving Ground)	-	-	-	169.2	-	36.7
Transportation Sector Daily Hours of Delay Reductions (Additional Off-model Strategies)							
56	Expanded deployment of CHART (all principal arterials)	-	-	11,322	-	-	11,525
57	Corridor signal synchronization, intelligent transportation systems (ITS), traveler information	-	-	9,535	-	-	9,707



US 40 CNC Scenario Tests - GHG Emissions							
GHG Emissions (mmt CO2e)		2006 Base	Scenario 1 2035	Scenario 2 2035	Scenario 3 2035	Scenario 4 2035	Scenario 5 2035
Transportation Sector Annual Emissions (mmt CO2e)							
ON-ROAD MOBILE EMISSIONS							
1	Existing National Programs (see Appendix L, Table L.18)	1.57	1.77	1.83	1.79	1.77	1.75
Proposed Vehicle Technology Programs							
2	Maryland Clean Car /National Fuel Economy Standards (2017-2025)	-	(0.46)	(0.48)	(0.46)	(0.46)	(0.45)
3	Medium/Heavy Duty Truck Standards (2014-2018)	-	-	(0.25)	-	-	(0.24)
Extend LDV programs at constant growth rate through 2035							
Transportation Fuel Programs							
4	Renewable Fuels Standard (EPA RFS2)	-	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
5	Low Carbon Fuels Standard	-	(0.18)	(0.18)	(0.18)	(0.18)	(0.18)
Additional Vehicle Technology Strategies							
6	Electric vehicle infrastructure and purchasing incentives	-	-	(0.04)	-	-	(0.03)
7	Hybrid/electric bus purchases	-	-	(0.00)	-	-	(0.00)
8	Hybrid truck initiative and truck stop electrification	-	-	(0.00)	-	-	(0.00)
9	Additional Off-Model Transportation Strategy GHG Reductions	-	-	(0.07)	(0.06)	-	(0.08)
10	Annual GHG Emissions (tons) per Household	15.80	8.11	4.75	6.43	8.11	5.44
OFF-ROAD MOBILE EMISSIONS							
11	Freight & Commuter Rail	0.09	0.11	0.11	0.11	0.11	0.11
12	Other Off-Road	0.27	0.33	0.33	0.33	0.33	0.33
13	TOTAL MOBILE EMISSIONS	1.92	1.53	1.22	1.48	1.53	1.17
All Other Sector Annual Emissions (mmt CO2e) (See Appendix L, Table L.17 for more detail)							
ELECTRICITY CONSUMPTION							
14	Residential	0.74	0.95	1.15	1.10	0.34	0.33
15	Commercial	0.62	0.92	1.11	1.07	0.21	0.21
16	Industrial	0.12	0.19	0.21	0.21	0.15	0.15
FUEL CONSUMPTION							
17	Residential	0.30	0.39	0.47	0.45	0.26	0.25
18	Commercial	0.17	0.25	0.30	0.29	0.16	0.16
19	Industrial	0.24	0.35	0.39	0.36	0.32	0.32
20	FOSSIL FUEL INDUSTRY	0.03	0.06	0.06	0.06	0.06	0.06
21	INDUSTRIAL PROCESSES	0.16	0.19	0.19	0.19	0.15	0.15
22	AGRICULTURE	0.02	0.02	0.02	0.02	0.02	0.02
WASTE MANAGEMENT							
23	Municipal Wastewater	0.02	0.02	0.02	0.02	0.02	0.02
24	Solid Waste	0.19	0.24	0.24	0.24	0.07	0.07
25	TOTAL ALL OTHER SECTOR EMISSIONS	2.61	3.57	4.16	4.01	1.75	1.74
26	Annual GHG emissions (tons) per household	10.46	9.89	9.89	9.49	4.43	4.33
27	Annual GHG emissions (tons) per commercial job	7.52	6.93	6.93	6.93	2.23	2.23
28	Annual GHG emissions (tons) per industrial job	26.53	24.40	24.40	24.40	21.04	21.04
Total Annual Multi-Sector Corridor Emissions (mmt CO2e)							
29	TOTAL MULTI-SECTOR EMISSIONS	4.54	5.10	5.38	5.49	3.28	2.91
Total Corridor Annual Carbon Sequestration (mmt CO2e) (See Appendix L, Table L.17 for more detail)							
30	EMISSION SINKS - TOTAL FOREST CARBON SEQUESTRATION	(0.30)	(0.24)	(0.24)	(0.27)	(0.29)	(0.29)
Conservation & Restoration Strategies							
31	Intensive Forest Management					(0.01)	(0.01)
32	Urban Tree Canopy					(0.12)	(0.12)
33	Agricultural Lands Preservation					(0.07)	(0.07)
34	Aforestation (excluding APG)					(0.00)	(0.00)
35	Reforestation - Riparian Buffers (excluding APG)					(0.00)	(0.00)
36	TOTAL CONSERVATION & RESTORATION STRATEGIES	-	-	-	-	(0.21)	(0.21)
Total Net Annual Corridor Emissions (mmt CO2e)							
37	TOTAL NET CORRIDOR EMISSIONS (mmt CO2e)	4.24	4.86	5.14	5.22	2.99	2.41
Total Net Annual Corridor Emissions per Household (tons CO2e)							
38	Annual GHG Emissions per Household (Transportation Sector - On-Road)	15.80	8.11	4.75	6.43	8.11	5.44
39	Annual GHG Emissions per Household (Residential Sector)	10.46	9.89	9.89	9.49	4.43	4.33
40	Annual GHG Emissions per Household (TOTAL)	26.26	18.00	14.64	15.92	12.55	9.77
Percent Change From 2006 Corridor GHG Emissions							
41	Total Corridor Transportation Sector GHG Emissions		-20%	37%	23%	20%	-39%
42	Total Corridor Other Sector GHG Emissions		36%	-59%	-53%	33%	-34%
43	Total Corridor Multi-Sector GHG Emissions		12%	19%	21%	-39%	-36%
44	Total Corridor Net Multi-Sector GHG Emissions		15%	21%	23%	-29%	-43%

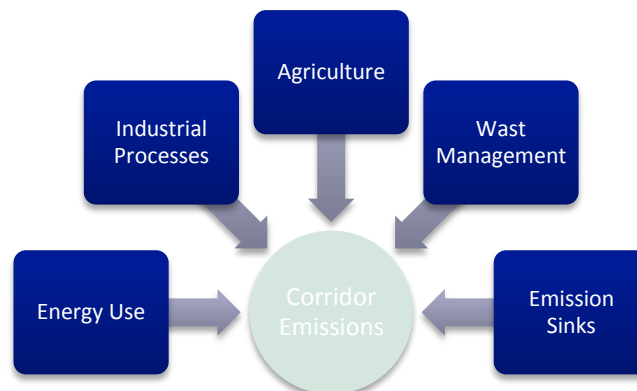
L. GHG Emissions Modeling Assumptions and Methodology

Background

This technical report documents the methodology and assumptions used to develop the U.S. 40 Carbon Neutral Corridor (CNC) greenhouse gas (GHG) emissions inventory and business as usual (BAU) forecasts for all sectors. Corridor emissions have been estimated for a 2006 baseline and for three BAU forecast scenarios: 2020, 2035 and 2050.

As illustrated in Figure L.1 corridor GHG emissions were calculated for energy used in the residential, commercial, and industrial (RCI) sectors, as well as the transportation sector, which includes on-road transportation, freight and commuter rail, aviation, and off-road vehicles. Non-energy-related emissions resulting from industrial processes, agriculture processes (both animal and plant related), and waste management activities within the corridor are also included. In addition, emission savings or sinks resulting from forested acres, urban tree cover and landfilled yard trimmings and food scraps within the corridor were accounted for.

Figure L.1 Corridor Emission Sectors



The on-road transportation inventory was calculated by estimating emissions for carbon dioxide (CO₂), methane (CH₄), and nitrous oxide (N₂O). Those emissions were then converted to carbon dioxide equivalents that are measured in the units of million metric tons (mmt CO₂e). Carbon dioxide represents about 97 percent of the transportation sector's GHG emissions. The on-road portion of the transportation sector inventory was developed using EPA's new emissions model MOVES (Motor Vehicle Emissions Simulator).

Inventory and forecast emissions for all other sectors were calculated using a "top-down" approach which involved estimating state emissions and factoring them down to the corridor-



level based on key demographic indicators such as population, employment, households and land use. The off-road portion of the corridor's inventory was produced using EPA's State Greenhouse Gas Inventory Tool (SIT), dated February 26, 2010.

Summary of Data Sources

On-Road Data Sources

A summary of key input data sources and assumptions are provided in Table L.1. Many of these data inputs are consistent with those used for SIP inventories and conformity analyses. Traffic volumes and vehicle miles traveled (VMT) are based on the Baltimore Regional Transportation Board's (BRTB) travel model highway networks with additional VMT adjustments applied to account for missing local and off-network VMT.

For the 2006 inventory, the 2000 model network was used and post-VMT adjustments were applied to the network VMT to match the 2006 Highway Performance Monitoring System (HPMS) in the study area. For the 2035 scenarios analyses, the same 2006 HPMS adjustments (additive) were applied to the 2035 scenario networks.

Separate procedures were applied to account for missing local VMT not contained within the regional travel model's representation of the corridor. The proportion of local vs. regional roadway mileage was calculated for each county using roadway segment information from the State Highway Administration (SHA). These percentages were then used to factor existing corridor local VMT.

Vehicle population is a key input that has an important impact on start and evaporative emissions. At the time of this study, final decisions (per Maryland Department of the Environment (MDE) consultation) had not been made on the use of Maryland registration data as a surrogate for vehicle population. In urban areas, registration data can over-estimate the actual number of daily vehicle trips due to high transit usage. As a result, for this study, vehicle population was calculated from VMT using MOVES default estimates for the typical miles per vehicle by source type (e.g. vehicle type). The PPSUITE emissions post processor automatically prepares the vehicle population file under this method. This alternative was determined to be acceptable for this inventory, especially considering that start and evaporative emissions are much lower for CO₂ as compared to other pollutants.

The vehicle mix is another important file that is used to disaggregate total vehicle volumes and VMT to the 13 MOVES source types. MDE is currently reviewing options to prepare these data input assumptions using MOVES. For this inventory, the vehicle mix was calculated based on 2008 Maryland State Highway Administration (SHA) vehicle type pattern percentages by functional class, which disaggregates volumes to four vehicle types: light-duty vehicles, heavy-duty vehicles, buses, and motorcycles. As illustrated in Figure L.2, the four vehicle groups were related to EPA's MOBILE6.2 weight-based vehicle categories. EPA's MOVES Technical Guidance was then used to convert the MOBILE6.2 categories to the MOVES source types.



Figure L.2 Defining Vehicle Types

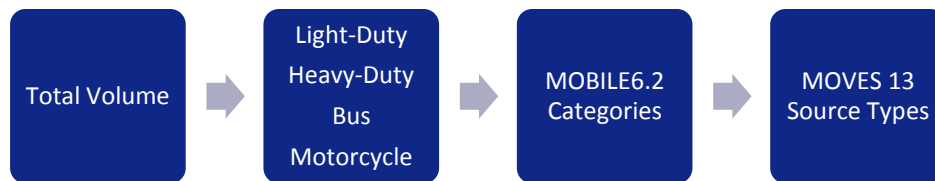


Table L.1 Summary of Key On-Road Data Sources

Data Item	Source	Description	Difference between 2006 and 2035
<i>Roadway Characteristics</i>	2000 Network from the Baltimore Regional Transportation Board's (BRTB) Regional Travel Demand Model	Includes lanes, segment distance, facility type, speed limit	2035 Scenario Networks from the BRTB Regional Travel Demand Model
<i>Traffic Volumes</i>	2000 Network from the BRTB Regional Travel Demand Model	Average Annual Daily Traffic Volumes (AADT)	2035 Scenario Networks from the BRTB Regional Travel Demand Model
<i>Seasonal Adjustments</i>	SHA 2008 ATR Station Reports in the Traffic Trends System Report Module from the SHA website	Adjust AADT to average day in each month	Same Data Source
<i>VMT</i>	Highway Performance Monitoring System 2006	Used to adjust VMT to the reported 2006 HPMS totals by county and functional Class	Apply 2006 HPMS VMT Adjustments 2035 Scenario Networks
<i>Hourly Patterns</i>	SHA 2006-2008 Traffic Trends System Report Module from the SHA website	Used to disaggregated volumes and VMT to each hour of the day	Same Data Source
<i>Vehicle Type Mix</i>	2008 SHA vehicle pattern data; MOVES Technical Guidance	Used to split traffic volumes to the 13 MOVES vehicle source types	Same Data Source
<i>Ramp Fractions</i>	Calculated by PPSUITE Post Processor	Calculates ramp fractions by area type	Calculated by PPSUITE Post Processor
<i>Vehicle Ages</i>	2008 Maryland Registration data	Provides the percentage of vehicles by each model year age	Same Data Source
<i>Hourly Speeds</i>	Calculated by PPSUITE Post Processor	Hourly speed distribution file used by MOVES to estimate emission factors	Calculated by PPSUITE Post Processor



<i>I/M Data</i>	Provided by MDE	Based on 2006 and current I/M program	Different I/M Program Characteristics
<i>Fuel Characteristics</i>	Provided by MDE	Fuel characteristics vary from 2006-2012 then constant to 2020	Different Fuel Characteristics
<i>Temperatures</i>	Provided by MDE	Average Monthly Temperature sets	Different Temperatures Data
<i>Vehicle Population</i>	Calculated by PPSUITE Post Processor; MOVES Default Miles/Vehicle Data	Vehicle population calculated by PPSUITE from VMT using MOVES Default miles/vehicle estimates	Calculated by PPSUITE Post Processor; MOVES Default Miles/Vehicle Data

Off-Road Transportation and Other Sectors

Table L.2 summarizes the key demographic information used in the “top-down” approach for estimating emissions from all off-road sources within the corridor by analysis year. Population, household, employment, and land use estimates were derived at the corridor level from the BRTB’s Round 7-C Cooperative Forecast data for Baltimore by transportation analysis zone (TAZ). State estimates were obtained from the Maryland Department of Planning’s (MDP) Maryland State Data Center (SDC). Specific land use data and assumptions are illustrated where appropriate in the sector-by-sector analysis approach section of this document. Table L.3 illustrates the additional key data sources utilized to calculate the off-road portion of the baseline and forecast emissions inventory.

Table L.2 Key Corridor and State Demographic Information

	2006	2020	2035	2050
Population				
<i>Corridor</i>	268,301	309,609	331,347	369,568
<i>State</i>	5,548,822	6,339,300	7,121,537	8,000,298
Households				
<i>Corridor</i>	104,621	123,483	134,345	152,896
<i>State</i>	2,095,889	2,457,625	2,830,104	3,259,035
Employment				
<i>Corridor</i>	128,202	178,758	190,603	269,995
<i>Commercial</i>	113,354	157,855	168,486	238,430
<i>Industrial</i>	14,849	20,903	22,117	31,565
<i>State</i>	3,398,729	3,891,500	4,419,451	5,062,449
<i>Commercial</i>	3,001,713	3,466,753	3,903,202	4,471,089
<i>Industrial</i>	397,016	424,747	516,249	591,360



Table L.3 Summary of Key Off-Road Data Sources

Data Item	Source		Sector (s)
	Statewide	Corridor	
<i>Emission Factors</i>	SIT		All except Electricity Production and Aviation
<i>Electricity Consumption Rates</i>	SIT	NA	Electricity Consumption
<i>CP Crane Emissions</i>	NA	RGGI	Electricity Production
<i>RCI Consumption Rates</i>	SIT	NA	RCI Fuel Use
<i>Total Freight Ton-Miles</i>	TRANSEARCH®		Freight Rail
<i>Commuter Rail Vehicles Operating at Maximum Service</i>	National Transit Database	Cambridge Systematics	Commuter Rail
<i>Airport Operations Data</i>	AirNAV.com		Aviation
<i>Natural Gas Transmission & Distribution Emissions Statewide</i>	Maryland 2008 CAP	NA	Fossil Fuel Industry
<i>Cement, Iron & Steel, & Aluminum Manufacturers</i>	U.S. Census Bureau County Business Patterns		Industrial Processes
<i>National ODS Substitutes Emissions</i>	SIT	NA	Industrial Processes
<i>Statewide SF₆ Consumption Rate</i>	SIT	NA	Industrial Processes
<i>Land Use</i>	MDP	BRTB Round 7-C	Agriculture and Emission Sinks

Sector-by-Sector Analysis Process

Energy Use

Energy use includes emissions resulting from the subsectors of electricity consumption, electricity production, RCI fuel use and transportation.

Electricity Consumption

The base 2006 emissions that result from the indirect consumption of fuels used to produce electricity for the residential, commercial and industrial sectors were estimated utilizing 2006 statewide energy consumption by sector and an emission factor that accounts for the fuel-type used to generate the electricity and any losses, obtained from the SIT module, *CO₂ Emissions from Electricity Consumption*. Statewide energy consumption rates were factored down to the corridor level for inventory and forecast years using households for residential energy use and employment for commercial and industrial energy use. Table L.4 illustrates the total corridor electricity consumption estimated by sector by analysis year. The SIT emission factor of 1.21 lbs CO₂e/kWh was applied to the electricity consumption by sector to calculate total corridor emissions attributable to the consumption of electricity.



Table L.4 Annual CNC Electricity Consumption by Sector by Analysis Year (kWh)

Sector	2006	2020	2035	2050
<i>Residential</i>	1,343,118,636	1,585,267,953	1,724,713,711	1,962,864,651
<i>Commercial</i>	1,122,719,075	1,563,487,498	1,668,783,089	2,361,545,079
<i>Industrial</i>	226,554,062	318,922,647	337,444,968.57	481,596,201.80

Electricity Production

The estimated 2006 emissions for electricity production within the corridor are based on data obtained from the Regional Greenhouse Gas Initiative (RGGI) for the CP Crane Power Plant, which is a coal-fired power plant located in the corridor. The emissions generated by the CP Crane plant were held constant at 1.89 mmt CO₂e through 2050. This is assumed to be a conservative estimate given the goal of RGGI to reduce power plant emissions in the future.

Residential, Commercial, and Industrial Fuel Use

Statewide CH₄, N₂O and CO₂ emissions resulting from the direct energy consumption of fuels for residential, commercial and industrial fuel use were estimated using 2006 region- and fuel-specific emission factors and statewide consumption estimates from the SIT modules, *CO₂ Emissions from Combustion of Fossil Fuels*, and *CH₄ and N₂O Emissions from Stationary Combustion*. The consumption rates and emission factors were held constant at the 2006 levels and factored down to the corridor level for inventory and forecast years using households for residential emissions and employment for commercial and industrial emissions. Table L.5 illustrates the emissions factors by fuel type for the residential and commercial sectors. Table L.6 shows the annual fuel consumption for the residential and commercial sectors by analysis year, and Table L.7 illustrates the industrial sector emission factors and fuel consumption by fuel type and analysis year.

Table L.5 Residential and Commercial Emission Factors by Fuel Type

Fuel Type	CO ₂ (lbs C/ million Btu)	CH ₄ (metric tons CH ₄ /billion Btu)	N ₂ O (metric tons N ₂ O/billion Btu)
<i>Coal</i>	56.79	0.30069 ¹	0.00150
<i>Distillate Fuel</i>	43.94	0.01002	0.00060
<i>Kerosene</i>	43.44	0.01002	0.00060
<i>LPG</i>	37.91	0.01002	0.00060
<i>Motor Gasoline</i>	42.62	NA	NA
<i>Residual Fuel</i>	47.33	NA	NA
<i>Natural Gas</i>	31.87	0.00475	0.00009
<i>Wood</i>	NA	0.28487	0.00380

¹ Represents residential emission factor. Commercial emission factor equals 0.01002 (metric tons CH₄/billion Btu).



Table L.6 Residential and Commercial Annual CNC Fuel Consumption by Fuel Type

Fuel Type	Residential Consumption (Billion Btu)				Commercial Consumption (billion Btu)			
	2006	2020	2035	2050	2006	2020	2035	2050
<i>Coal</i>	4.70	5.54	6.03	6.86	35.92	50.03	53.40	75.56
<i>Distillate Fuel</i>	984.32	1,161.78	1,263.97	1,438.50	396.28	551.86	589.02	833.54
<i>Kerosene</i>	123.67	145.96	158.80	180.73	13.35	18.59	19.84	28.08
<i>LPG</i>	331.72	391.53	425.97	484.78	44.29	61.67	65.82	93.15
<i>Motor Gasoline</i>	NA	NA	NA	NA	6.45	8.99	9.59	13.58
<i>Residual Fuel</i>	NA	NA	NA	NA	11.39	15.86	16.92	23.95
<i>Natural Gas</i>	3,684.46	4,348.72	4,731.25	5,384.55	2,456.14	3,420.39	3,650.74	5,166.28
<i>Wood</i>	344.58	406.71	442.48	503.58	79.35	110.50	117.94	166.90

Table L.7 Industrial Emission Factors and Annual CNC Fuel Consumption by Fuel Type

Fuel Type	Emission Factors			Fuel Consumption (billion Btu)			
	CO ₂ (lbs C/ million Btu)	CH ₄ (metric tons CH ₄ /billion Btu)	N ₂ O (metric tons N ₂ O/billion Btu)	2006	2020	2035	2050
<i>Other Coal</i>	56.85	0.0100230	0.0015035	1,138	1,602.18	1,695.24	2,419.41
<i>Distillate Fuel</i>	43.94	0.0030069	0.0006014	463	652.16	690.04	984.81
<i>Feedstocks, Naphtha less than 401 F</i>	39.96	0.0030069	0.0006014	11	14.92	15.78	22.52
<i>Feedstocks, Other Oils greater than 401 F</i>	43.94	0.0030069	0.0006014	19	26.50	28.04	40.02
<i>Kerosene</i>	43.44	0.0030069	0.0006014	6	9.07	9.60	13.69
<i>LPG</i>	37.45	0.0030069	0.0006014	69	96.84	102.47	146.24
<i>Lubricants</i>	44.58	NA	NA	73	102.94	108.92	155.44
<i>Motor Gasoline</i>	42.62	0.0030069	0.0006014	194	272.42	288.25	411.38
<i>Misc. Petro Products</i>	44.82	NA	NA	6	8.27	8.75	12.49
<i>Pentanes Plus</i>	40.18	0.0030069	0.0006014	3	4.54	4.80	6.85
<i>Residual Fuel</i>	47.33	0.0030069	0.0006014	178	250.98	265.56	379.00
<i>Special Naphthas</i>	43.74	0.0030069	0.0006014	115	162.00	171.41	244.63
<i>Waxes</i>	43.63	NA	NA	4	5.33	5.64	8.05
<i>Natural Gas</i>	31.87	0.0009496	0.0000950	861	1,211.93	1,282.31	1,830.10
<i>Wood</i>	NA	0.0284865	0.0037982	455	640.51	677.71	967.22



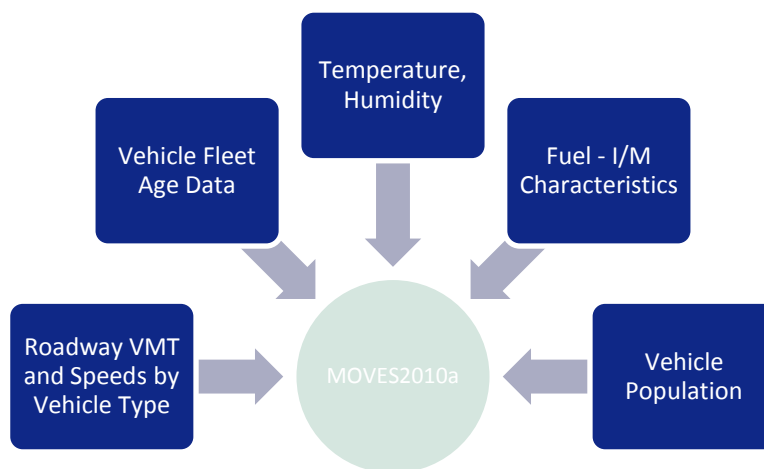
Transportation

On-Road

The data, tools and methodologies employed to conduct the on-road vehicle GHG emissions inventory were developed in close consultation with MDE and are consistent with the *Technical Guidance on the Use of MOVES2010 for Emission Inventory Preparation in State Implementation Plans and Transportation Conformity*, EPA-420-B-10-023, April 2010. EPA's MOVES model was officially released on March 2, 2010 and was followed with a revised version (MOVES2010a) in August 2010. The MOVES2010a version incorporates new car and light truck greenhouse gas emissions standards for model years 2012-2016 and updates effects of corporate average fuel economy (CAFE) standards for model years 2008-2011. The MOVES2010a model estimates the reductions in greenhouse gases associated with those standards in future calendar years.

As illustrated in Figure L.3, the MOVES2010a model has been integrated with local traffic, vehicle fleet, environmental, fuel, and control strategy data to estimate emissions for the US 40 corridor.

Figure L.3 Emission Calculation Data Process



The modeling assumptions and data sources were developed in coordination with MDE and are consistent with other SIP-related inventory efforts. The process represents a “bottom-up” approach to estimating GHG emissions based on available roadway and traffic data.

GHG emission values are reported as annual numbers for 2006 and the 2035 BAU (presented only in the trends analysis in Appendix F), and the alternative U.S. 40 CNC scenarios (Scenario 1 – 5). The annual values were calculated based on 12 monthly MOVES runs as summarized in Figure L.4. Each monthly run used traffic volumes, speeds, temperatures and fuel values specific to an average day in each month.

Figure L.4 Calculation of Annual Emissions

For the 2006 inventory and the 2035 BAU forecast, the traffic data was based on roadway segment data from the BRTB regional travel demand model. This data does not contain information on congested speeds and the hourly detail needed by MOVES. As a result, post processing software (PPSUITE) was used to calculate hourly congested speeds for each roadway link, apply vehicle type fractions, aggregate VMT and VHT, and prepare MOVES traffic-related input files. The PPSUITE software and process methodologies are consistent with that used for state inventories and transportation conformity analyses throughout Maryland.

Other key inputs including vehicle population, temperatures, fuel characteristics and vehicle age were obtained from and/or prepared in close coordination with MDE staff. The following sections summarize the key input data assumptions used for the inventory runs.

Vehicle Technology Adjustments

The 2035 BAU includes the effects of the following post-2006 vehicle programs on future vehicle emission factors included in the MOVES2010a emission model:

- *CAFE Standards (Model Years 2008-2011)* – Vehicle model years through 2011 are covered under existing CAFE standards that will remain intact under the Obama Administration’s national program.
- *National Program (Model Years 2012-2016)* – The light-duty vehicle fuel economy for model years between 2012 and 2016 are based on the May 7, 2010 Rule “*Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards; Final Rule*” (EPA-HQ-OAR-2009-0472-11424;<http://www.regulations.gov/#!documentDetail;D=EPA-HQ-OAR-2009-0472-11424>). Fuel economy improvements begin in 2012 until an average 250 gram/mile CO₂ standard is met in year 2016. This equates to an average fuel economy near 35 mpg.

Alternative carbon neutral corridor scenarios (Scenario 1 – 5) also evaluate the impacts of potential legislation that will further improve vehicle fuel economy and/or average vehicle GHG emissions per mile. The technology improvements included in the U.S. 40 CNC scenarios include:

- The Maryland Clean Car Program that incorporates the California emission standards (Scenario 1 – 5).
- The proposed light-duty vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for Model Years 2017-2025 (Scenario 1 – 5).
- The proposed Greenhouse Gas Emissions Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles for Model Years 2014-2018 (Scenario 1 – 5).



- Extended the proposed fuel economy improvements for 2017-2025 light duty vehicles at a constant growth rate through 2035 (Scenario 2 and 5 only).

The above proposed technology programs were not included in the 2035 BAU, as they are included as credits assigned to the Scenario's compared to 2035 BAU emissions. To model the potential emission credits of the proposed vehicle technology programs, the MOVES2010a default database was revised. Fuel economy assumptions within MOVES2010a are provided as vehicle energy consumption rates within the "EmissionRates" table as illustrated in Figure L.5.

Figure L.5 MOVES Default "EmissionRate" Table

sourceBinID	polProcessID	opModelID	meanBaseRate	meanBaseRate...	meanBaseRateIM	meanBaseRate...	dataSourceId
101014690000000000	601	300	0.814636	HULL	0.814636	HULL	406
101014790000000000	601	300	0.814636	HULL	0.814636	HULL	406
101014690000000000	602	100	0.294065	HULL	0.294065	HULL	406
101014790000000000	602	100	0.294065	HULL	0.294065	HULL	406
101014694000000000	601	300	0.814636	HULL	0.814636	HULL	406
101014794000000000	601	300	0.814636	HULL	0.814636	HULL	406
101014694000000000	602	100	0.294065	HULL	0.294065	HULL	406
101014794000000000	602	100	0.294065	HULL	0.294065	HULL	406
101014685000000000	601	300	0.517222	HULL	0.517222	HULL	406
101014685000000000	602	100	0.186705	HULL	0.186705	HULL	406
101014695000000000	601	300	0.814636	HULL	0.814636	HULL	406
101014795000000000	601	300	0.814636	HULL	0.814636	HULL	406
101014695000000000	602	100	0.294065	HULL	0.294065	HULL	406
101014795000000000	602	100	0.294065	HULL	0.294065	HULL	406
101014696000000000	601	300	1.55422	HULL	1.55422	HULL	406
101014796000000000	601	300	1.55422	HULL	1.55422	HULL	406
101014696000000000	602	100	0.56104	HULL	0.56104	HULL	406
101014796000000000	602	100	0.56104	HULL	0.56104	HULL	406
101014697000000000	601	300	1.66641	HULL	1.66641	HULL	406
101014797000000000	601	300	1.66641	HULL	1.66641	HULL	406
101014697000000000	602	100	0.601537	HULL	0.601537	HULL	406
101014797000000000	602	100	0.601537	HULL	0.601537	HULL	406
101014698000000000	601	300	1.69944	HULL	1.69944	HULL	406

To model the benefits of the proposed vehicle technology programs, the database was revised so that all energy rates reflect the proposed fuel standards for each vehicle type, model year and fuel type. The table was updated per the following steps:

1. Open the "EmissionRate" table in the latest MOVES2010a default database (named: movesdb20100830). The fields to be modified include: meanBaseRate & meanBaseRateIM (values in both fields are the same)
2. Select records in the table that are related to energy consumption. This includes records with the polProcessID = 9101, 9102 and 9190.
3. Use the sourceBinID field to determine how each record correlates to vehicle type, model year and fuel type.
4. Modify meanBaseRate & meanBaseRateIM fields to reflect fuel standards for the applicable vehicle type, model year and fuel type.



Freight & Commuter Rail

Freight rail emissions were calculated utilizing TRANSEARCH® data that was developed by IHS Global Insight and updated to 2006 and 2035 by Cambridge Systematics, Inc. for use in Maryland's September 2009 Statewide Freight Plan. Inbound, outbound, local and through rail ton-miles within the corridor for the years 2020 and 2050 were interpolated using the corridor 2006 and 2035 values obtained from the previously mentioned data sources. Table L.8 illustrates the total freight ton-miles estimated by year within the U.S. 40 Corridor. The Greenhouse Gas Protocol (GHG Protocol) Calculation Tool, GHG emissions from transport or mobile sources, Version 2.0 (June 2009) was utilized to determine the GHG emissions associated with the freight rail ton-miles within the corridor.

Table L.8 Total Annual CNC Freight Ton-Miles

	2006	2020	2035	2050
<i>Rail Ton-Miles</i>	857,903,512	1,257,431,807	1,685,497,837	2,113,563,867

Commuter rail emissions within the corridor were estimated assuming that there are 16 daily MARC trains with boarding/alighting at Aberdeen, Edgewood or Martin State Airport and 12 Amtrak northeast regional trains with boarding / alighting at Aberdeen. Statewide commuter rail emissions were estimated utilizing the total vehicles operating at maximum service (VOMS) from the 2007 National Transit Database, *Table 17: Energy Consumption*, and the total electricity consumption attributable to heavy rail statewide from the SIT module, *CO₂ Emissions from Electricity Consumption*. A consumption factor of 4,339,874 (kWh) per VOMS was developed and applied to the total of 28 VOMS in service within the corridor. An emission factor, including losses, of 1.21 (lbs CO₂E/kWh) obtained from the SIT module, *CO₂ Emissions from Electricity Consumption*, was applied to estimate total commuter rail emissions within the corridor. Commuter rail emissions were calculated for 2007 and used as a surrogate for 2006. In order to develop a conservative estimate, emissions were held constant at the 2007 rate for future years.

Aviation

The aviation inventory and forecast emissions within the corridor include the CH₄, N₂O and CO₂ emissions resulting from the consumption of aviation gasoline and jet fuel kerosene at Martin State Airport. 2006 airport operations data obtained from AirNav.com were used to determine that five percent of statewide airport operations take place at Martin State Airport and were used to similarly apportion statewide fuel use to the corridor level. Statewide emission factors and statewide fuel use were obtained from two SIT modules, *CO₂ Emissions from the Combustion of Fossil Fuels* and *CH₄ and N₂O from Mobile Combustion*. Table L.9 illustrates the emission factors and annual fuel consumption by fuel type obtained from the SIT module for aviation gasoline and kerosene jet fuel. Forecast emissions were estimated using the corridor's population growth as a surrogate to grow fuel usage.



Table L.9 Aviation Emission Factors and Annual CNC Fuel Consumption by Fuel Type

Fuel Type	Emission Factors / Energy Content				Fuel Consumption (Billion Btu)			
	CO ₂ (lbs C/Million Btu)	Energy Content (kg/Million Btu)	N ₂ O (g/kg fuel)	CH ₄ (g/kg fuel)	2006	2020	2035	2050
<i>Aviation Gasoline</i>	4.70	5.54	6.03	6.86	27	30	32	35
<i>Jet Fuel, Kerosene</i>	984.32	1,161.78	1,263.97	1,438.50	1,153	1,296	1,394	1,492

Other Off-Road

Inventory and forecast emissions for this subsector of emissions includes CH₄, N₂O, and CO₂ emissions resulting from the operation of diesel and gasoline tractors, construction equipment and other non-highway equipment used in primarily industrial applications. A per capita, statewide emissions factor was generated utilizing the SIT module, *CH₄ and N₂O Emissions from Mobile Combustion*. Total 2006 statewide emissions, as illustrated in Table L.10, were divided by 2006 statewide population to generate a per capita emissions factor of 0.0000006754 mmtCO₂e, which was applied to forecast corridor populations in order to arrive at estimated future corridor emissions.

Table L.10 Total 2006 Maryland Statewide Off-Road Vehicle Emissions

Equipment Type	mmtCO ₂ e
<i>Farm</i>	0.516
<i>Construction</i>	2.432
<i>Other</i>	0.800
Total	3.748

Fossil Fuel Industry

The inventory and forecast emissions for this subsector of energy consumption includes CH₄, N₂O, and CO₂ emissions associated with the transmission and distribution of fossil fuels. It is assumed that there is no oil production, oil or natural gas processing or coal production within the corridor. This section includes only emissions from the transmission and distribution of natural gas within the corridor. 2000, 2005, and 2020 statewide transmission and distribution emissions were obtained from the 2008 Maryland Climate Action Plan (CAP). 2005 emissions were used as a surrogate for 2006 statewide natural gas transmission and distribution emissions and growth rates based on the CAP were applied to calculate statewide transmission and distribution emissions for the future years of 2020, 2035 and 2050. Statewide natural gas consumption rates, which were generated for use in the RCI sector of this analysis, were used to develop fuel consumption-based transmission and distribution emission factors. The emission factors were applied to the corridor natural gas consumption rates, also generated for use in the RCI sector of this analysis and illustrated in Table L.11, in order to estimate emissions at the corridor level.



Table L.11 CNC Natural Gas Consumption by Sector (billion Btu)

Emission Source	2006	2020	2035	2050
<i>Residential</i>	3,684	4,349	4,731	5,385
<i>Commercial</i>	2,456	3,420	3,651	5,166
<i>Industrial</i>	861	1,212	1,282	1,830
Total	7,002	8,981	9,664	12,381

Industrial Processes

Industrial process emissions are generated as a result of a wide range of activities spanning several industries. The corridor analysis focuses on the following relevant industries as outlined in the 2008 Maryland Climate Action Plan:

- CO₂ from the production of cement, iron and steel;
- Hydrofluorocarbons (HFCs) and Perfluorocarbons (PFCs) from consumption of substitutes for ozone-depleting substances (ODS) used in cooling and refrigeration equipment;
- Sulfur hexafluoride (SF₆) transformers used in electric power transmission and distribution systems; and
- PFCs from aluminum production.

Cement, Iron & Steel, and Aluminum Manufacture

Emissions were estimated for these sources by apportioning statewide production for each of these sources down to the corridor level. Total statewide production for 2006 was obtained from the Cement Production in Maryland, Iron and Steel Production in Maryland, and the Maryland Aluminum Production spreadsheets in the SIT module, Industrial Processes. Information from the U.S. Census Bureau's County Business Patterns for 2006 was used to determine the total number of manufacturers located within the state and within the corridor based on North American Industry Classification System (NAICS) codes. An average production per establishment was generated and multiplied by emission factors obtained from the Industrial Processes SIT module. Table L.12 illustrates statewide and corridor manufacturers, production and emission factors used. Emissions for these sources were held constant at 2006 levels.

Table L.12 Cement and Iron and Steel Manufacture – Key Inputs

Industry	Manufacturers State / Corridor	Production (Metric Tons/Establishment)	Emission Factor (t CO ₂ /t production)
<i>Cement</i>	330 / 1	8,070	0.5070
<i>Iron & Steel</i>	30 / 1	25,537	0.7277
<i>Aluminum</i>	20 / 1	6,022	0.4254



ODS Substitutes

Emissions from ODS substitutes were estimated using 2006 national emissions available in the SIT model and apportioning them to the corridor level through generating a national per capita emissions factor (0.35 mmtCO₂e) and applying that factor to the corridor population for inventory and forecast years.

Electricity Transmission & Distribution

The emissions generated from the transmission and distribution of electricity are based on the amount of SF₆ used to insulate transmission and distribution equipment. An emission factor of 1.0 ton of SF₆ per ton of production and a statewide 2006 SF₆ consumption rate of 10 metric tons were obtained from the SIT module, *Industrial Processes*, and were used in conjunction with statewide and corridor electricity consumption in Table L.14 to develop the total corridor emissions. Emissions were held constant based on the number of establishments in the corridor in 2006.

Agriculture

Agricultural emissions within the corridor can be attributed to the management of agricultural soils, agricultural burning and the livestock sources of enteric fermentation and manure management. 2006 statewide agricultural emissions from these sources were obtained from the Methane and Nitrous Oxide Emissions from Agriculture module of the SIT model. Statewide land use was obtained from MDP. Corridor land use represents the latest data available from the BRTB's Round 7-C Cooperative Forecast. Animal-based land use categories included agricultural buildings, feeding operations and pasture. Crop-based land use categories included cropland, orchards/vineyards/horticulture, and row and garden crops. The percentage of statewide agricultural land use within the corridor, illustrated in Table L.13 was applied to the statewide 2006 emissions from the SIT model to apportion 2006 emissions to the corridor level.

Table L.13 2006 Statewide and CNC Agricultural Land Use

Land Use Type	State	Corridor	Corridor % of State
Animal-Based Agricultural Land Use			
<i>Ag. Buildings</i>	14,351	207	1.44%
<i>Feeding Operations</i>	13,126	54	0.41%
<i>Pasture</i>	223,795	1,718	0.77%
Total	251,272	1,979	0.79%
Crop-Based Land Use			
<i>Cropland</i>	1,850,025	17,940	0.97%
<i>Orchards / Vineyards / Horticulture</i>	12,542	338	2.69%
<i>Row & Garden Crops</i>	4,571	24	0.53%
Total	1,867,138	18,302	0.98%



Waste Management

Waste management emissions within the corridor were calculated within two areas: municipal wastewater treatment and solid waste management.

Municipal Wastewater Treatment

Municipal waste water treatment results in the emissions of CH₄ and N₂O. Methodologies contained in the *Municipal Solid Waste Module* of the SIT model were used to estimate emissions of both gases. The methodologies are based on population, the fraction of the population not on septic, i.e. the percentage of the population utilizing the municipal wastewater system, per capita emissions factors from SIT, and per capita biochemical oxygen demand (BOD) also obtained from the SIT model. Table L.14 illustrates the default values obtained from the SIT wastewater module, which were applied to the corridor population for inventory and forecast years to estimate emissions resulting from the treatment of municipal wastewater.

Table L.14 Default SIT Wastewater Module Values

Variable	Value
<i>Per Capita BOD</i>	0.09 kg/day
<i>Percent of BOD anaerobically digested</i>	16.25%
<i>CH₄ Emission Factor</i>	0.60 Gg CH ₄ /Gg BOD ₅
<i>Maryland Residents not on Septic</i>	79%
<i>N₂O Emission Factor</i>	4.0 g N ₂ O/person-year

Solid Waste Management

Solid waste management results in the production of CH₄ produced at landfills and N₂O produced when solid waste is burned. The corridor emissions were calculated by applying a per capita mmtCO₂e emissions factor of 7.20E-07, generated using statewide default data from the *Municipal Solid Waste Module* of the SIT model, to the corridor's population for 2006 and future years.

Emission Sinks

Emission sinks within the corridor can be attributed to three areas: forested acres, urban trees, and landfilled yard trimmings and food scraps. Emission reductions for all emission sinks were held constant at 2006 levels.

Forest Carbon Flux

Brush, deciduous forest, evergreen forest, and mixed forest land use categories at the state and corridor levels were used to estimate the total sinks attributable to forest carbon flux. Statewide land use was obtained from MDP. Corridor land use represents the latest data available from the BRTB's Round 7-C forecast. Table L.15 illustrates the 2006 statewide and corridor land use used to estimate forest carbon emission sinks at the corridor level. The percentage of statewide land use within the corridor was applied to the statewide 2006 emissions of 10.05 mmtCO₂e obtained from the SIT module, *Emission Sinks from Land Use, Land-Use Change, and Forestry* to estimate 2006 emissions at the corridor level.



Table L.15 2006 Statewide and CNC Forest and Carbon Flux Land Use Values

Land Use Type	State	Corridor	Corridor % of State
<i>Brush</i>	86,841	1,319	1.52%
<i>Deciduous Forest</i>	1,757,124	51,498	2.93%
<i>Evergreen Forest</i>	152,193	4,02	0.26%
<i>Mixed Forest</i>	581,994	3,095	0.53%
Total	2,578,152	56,314	2.18%

Urban Trees

High-density residential, low-density residential, medium-density residential and open urban land categories of land use were utilized to apportion the statewide emission levels obtained from the land use, land-change and forestry SIT module to the corridor level. Similar to the forest carbon flux, statewide land use was obtained from MDP and corridor land use represents the latest data available from the BRTB's Round 7-C forecast. Table L.16 illustrates the 2006 statewide and corridor land use used to estimate urban trees emission sinks at the corridor level. The percentage of statewide land use within the corridor was applied to the statewide 2006 emissions of 1.69 mmtCO₂e obtained from the SIT module, *Emission Sinks from Land Use, Land-Use Change, and Forestry* to estimate 2006 emissions at the corridor level.

Table L.16 2006 Statewide and CNC Urban Trees Land Use Values

Land Use Type	State	Corridor	Corridor % of State
<i>High-Density Residential</i>	76,910	7,645	9.94%
<i>Low-Density Residential</i>	571,818	15,586	2.73%
<i>Medium-Density Residential</i>	300,566	17,210	5.73%
<i>Open Urban Land</i>	68,213	3,555	5.21%
Total	1,017,507	43,996	4.32%

Landfilled Yard Trimmings & Food Scraps

The landfilled yard trimmings and food scraps were apportioned to the corridor level using 2006 statewide and corridor population estimates as illustrated in Table L.2, and statewide emissions of 0.18 mmtCO₂e from the *Emission Sinks from Land Use, Land-Use Change, and Forestry* SIT module.

Emission Results

Table L.17 illustrates the total estimated corridor emissions for the inventory and forecast years. The table also includes emission sinks and total emissions excluding emissions sinks.



Table L.17 Total CNC Emissions and Sinks by Sector and Analysis Year

Sector	2006	2020	2035	2050
TOTAL CORRIDOR EMISSIONS	4.39	5.19	5.63	7.03
Energy Use	4.30	5.05	5.47	6.82
Electricity Use (Consumption)	1.48	1.91	2.05	2.64
Residential	0.74	0.87	0.95	1.08
Commercial	0.62	0.86	0.92	1.30
Industrial	0.12	0.18	0.19	0.26
Electricity Production (C.P. Crane)	1.89	1.89	1.89	1.89
Residential Commercial Industrial (RCI) Fuel Use	0.71	0.93	0.99	1.30
Residential	0.30	0.36	0.39	0.44
Commercial	0.17	0.24	0.25	0.35
Industrial	0.24	0.34	0.35	0.51
Transportation	2.07	2.17	2.37	2.79
On-Road (with Fed. Programs)	1.72	1.76	1.93	2.31
Freight & Commuter Rail	0.09	0.10	0.11	0.12
Aviation (Martin State)	0.08	0.09	0.10	0.11
Other Off-Road	0.18	0.21	0.22	0.25
Fossil Fuel Industry	0.03	0.05	0.06	0.09
Natural Gas Industry	0.03	0.05	0.06	0.09
Industrial Processes	0.16	0.18	0.19	0.20
Cement Manufacture	0.03	0.03	0.03	0.03
Iron & Steel Manufacture	0.02	0.02	0.02	0.02
ODS Substitutes	0.09	0.11	0.12	0.13
Electricity Transmission & Dist.	0.01	0.01	0.01	0.01
Aluminum Production	0.01	0.01	0.01	0.01
Agriculture	0.02	0.02	0.02	0.02
Enteric Fermentation	0.003	0.003	0.003	0.003
Manure Management	0.003	0.003	0.003	0.003
Ag Soils	0.01	0.01	0.01	0.01
Ag Residue Burning	0.0001	0.0001	0.0001	0.0001
Waste Management	0.21	0.24	0.26	0.29
Municipal Wastewater	0.02	0.02	0.02	0.03
Solid Waste	0.19	0.22	0.24	0.27
Total Emissions (Excluding Sinks)	4.69	5.49	5.94	7.33
Emission Sinks	(0.30)	(0.30)	(0.30)	(0.30)
Forested Acres	(0.22)	(0.22)	(0.22)	(0.22)
Urban Acres	(0.07)	(0.07)	(0.07)	(0.07)
Landfilled Yard Trimmings & Food Scraps	(0.01)	(0.01)	(0.01)	(0.01)

Figure L.6 presents a percentage comparison of sector-by-sector emissions for years 2006 and 2035. The figure does not include electricity production emissions from the C.P. Crane plant, which equal 1.89 mmtCO₂e in 2006 and were held constant through 2035. Transportation



emissions represent 44.22 percent of total corridor emissions in 2006, decreasing to 39.90 percent by 2035.

Figure L.6 2006 and 2035 Sector-by-Sector Emissions

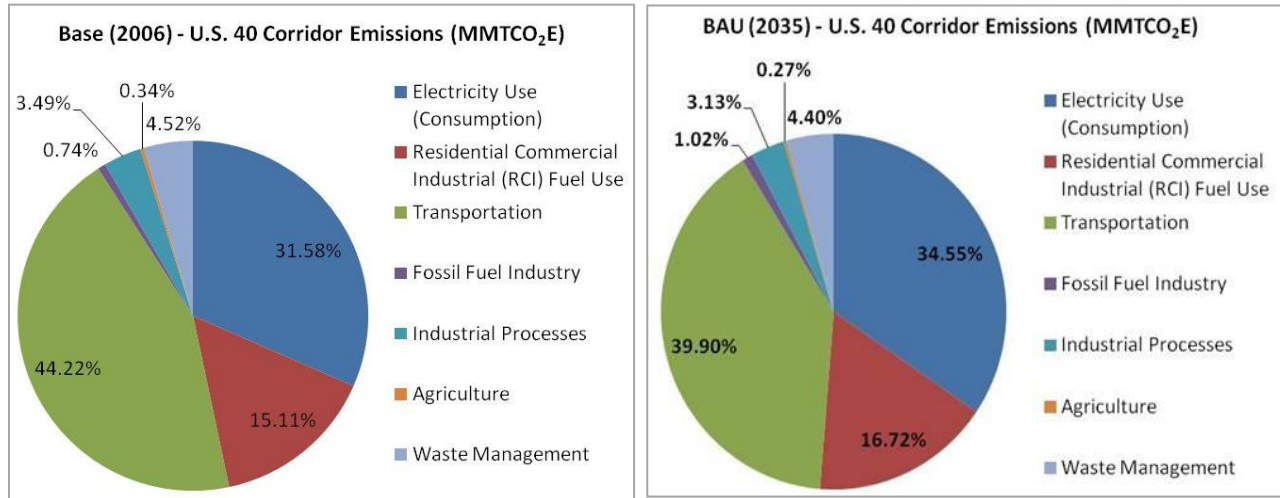
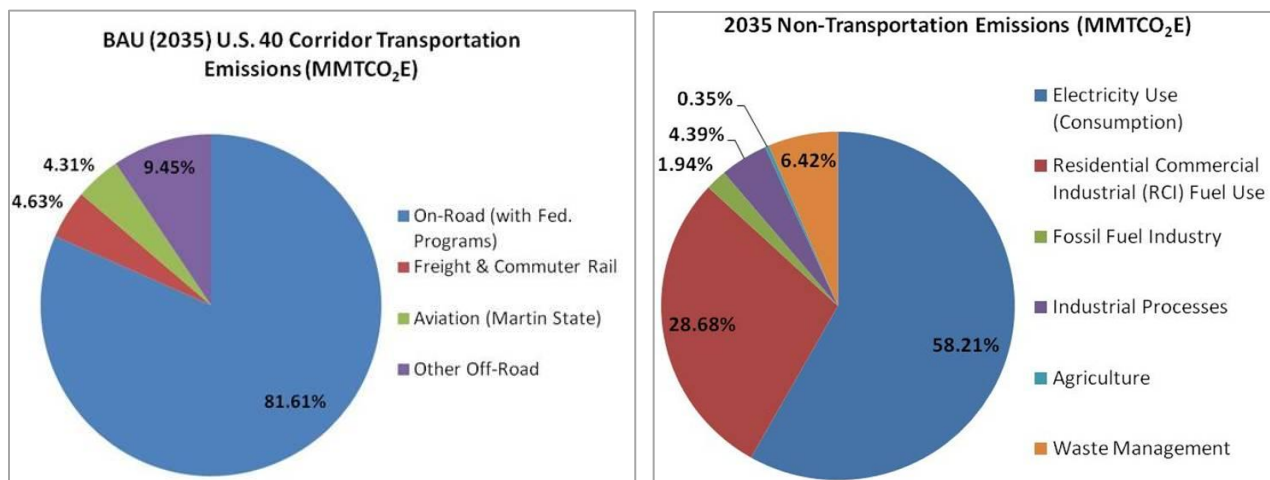


Figure L.7 illustrates the transportation and non-transportation sector emissions breakdown in 2035. The transportation sector breakdown includes emissions from on-road vehicles, freight and commuter rail, aviation, and other off-road sources. On-road sources account for 81.61 percent of total transportation emissions. The non-transportation sector breakdown includes all other emission sources within the corridor, with the exception of the emissions attributable to the generation of electricity at the C.P. Crane facility. Electricity use within the corridor accounts for over half of the non-transportation section emissions at approximately 58 percent.

Figure L.7 2035 Transportation and Non-Transportation Sector Emissions





Detailed On-Road Emission Results and Fuel Consumption Estimates

2006 and the 2035 Baseline (Scenario 1) emission results for the U.S. 40 CNC GHG inventory are provided in Table L.18. Emissions are also provided by fuel type and vehicle type.

Table L.18 2006 and 2035 Annual On-Road GHG Emissions (mmt CO₂e)

	2006		Scenario 1 2035		Scenario 2 2035		Scenario 3 2035	
	VMT (millions)	CO ₂ e	VMT (millions)	CO ₂ e	VMT (millions)	CO ₂ e	VMT (millions)	CO ₂ e
TOTAL	2,965	1.57	4,157	1.77	4,347	1.83	4,196	1.79
<i>By Fuel Type</i>								
Gasoline	2,694	1.17	3,754	1.18	3,939	1.24	3,786	1.20
Diesel	272	0.40	404	0.59	408	0.59	410	0.60
<i>By MOVES Vehicle Type</i>								
Motorcycle	5.8	0.002	9.1	0.004	9.5	0.004	8.9	0.004
Passenger Car	1,481.3	0.531	2,051.3	0.559	2,162.5	0.593	2,069.0	0.566
Passenger Truck	933.5	0.485	1,313.0	0.474	1,373.1	0.498	1,324.2	0.480
Light Commercial Truck	312.0	0.165	440.9	0.169	458.1	0.176	445.1	0.171
Intercity Bus	3.2	0.005	5.1	0.009	5.2	0.009	5.2	0.009
Transit Bus	8.3	0.011	13.2	0.018	13.4	0.019	13.6	0.019
School Bus	26.0	0.027	41.5	0.042	42.2	0.043	42.6	0.044
Refuse Truck	2.3	0.004	2.9	0.005	2.9	0.005	2.9	0.005
Single Unit Short-haul Truck	44.5	0.042	63.7	0.060	63.7	0.061	64.8	0.061
Single Unit Long-haul Truck	3.3	0.003	6.0	0.005	6.0	0.005	6.1	0.005
Motor Home	1.4	0.001	2.0	0.002	2.0	0.002	2.1	0.002
Combination Short-haul Truck	79.1	0.154	104.0	0.199	104.0	0.200	105.7	0.203
Combination Long-haul Truck	64.6	0.138	104.4	0.220	104.4	0.221	106.0	0.224

The MOVES output energy rates can be converted to fuel consumption values using standard conversion rates for gasoline and diesel fuel. Table L.19 provides the estimated 2006 and 2035 BAU fuel consumption values for 2006 and Scenarios 1, 2, and 3. Scenario 4 assumptions and VMT are identical to Scenario 1.

Scenario 5 is based on the same MOVES inputs for vehicle technology and fuels as included in Scenario 2, however has less VMT (see Appendix K) as a result of an alternative land use and transportation system.



Table L.19 2006 and 2020 BAU Fuel Consumption

Scenario	Fuel Type	MOVES2010a Output	
		Energy Consumption (million Btu)	Estimated Fuel Consumption ¹ (gallons)
Baseline 2006	Gasoline	15,009,234	120,810,328
	Diesel	5,224,873	37,673,035
Scenario 1 2035	Gasoline	15,449,865	124,356,999
	Diesel	7,551,115	54,445,998
Scenario 2 2035	Gasoline	16,276,045	131,006,981
	Diesel	7,626,027	54,986,133
Scenario 3 2035	Gasoline	15,656,203	126,017,830
	Diesel	7,712,036	55,606,288

¹ Assumes following conversion rates:

1 gallon of gasoline fuel = 124,238 BTU

1 gallon of diesel fuel = 138,690 BTU

http://www.eia.doe.gov/kids/energy.cfm?page=about_energy_conversion_calculator-basics



M. Conservation and Restoration Strategies

M.1 INTRODUCTION

Land conservation offers an important mechanism for mitigating and adapting to climate change. Deforestation and other land-use changes account for a significant share of global greenhouse gas (GHG) emissions. In addition, the increasing rate of sea level rise and associated erosion threaten Maryland's shoreline and coastal wetlands, removing natural sinks for GHGs. For these reasons, in addition to Chesapeake Bay restoration and protection, strategies to protect Maryland's network of natural areas (green infrastructure), agricultural lands, and coastal lands are a key element of the U.S. 40 CNC - Scenario 5.

Green infrastructure is an interconnected network of natural areas and other open spaces that maintains fully functioning ecosystems, sequesters CO₂, sustains clean air and water, and provides a wide array of benefits to people and wildlife. These lands include natural and managed forests. Green infrastructure planning is a systematic and strategic approach to land conservation used to develop a guide to an open space system. Implementation of green infrastructure plans includes such elements as land acquisition, conservation easements, purchase and transfer of development rights, tax credits and structures, and zoning. The toolbox also includes refining land-use planning policies and funding programs to allow users of these tools—governments, nongovernmental organizations, and private citizens—to more effectively protect green infrastructure.

This Appendix lists the existing conservation and natural resource preservation programs in the U.S. 40 corridor and recommendations for new best practices.

The U.S. 40 CNC Scenario 5 measures the direct GHG emissions impacts from strategies included in the Maryland Climate Change Commission's *Climate Action Plan*. These strategies include:

- protection, restoration, and management of forests, especially oak-hickory forests,
- protection, restoration, and management of tidal marsh, and
- urban tree planting and management.



M.2 EXISTING CONSERVATION AND NATURAL RESOURCE PRESERVATION PROGRAMS IN THE U.S. 40 CORRIDOR

Existing conservation and natural resources preservation programs that may contribute to or form strategies for the U.S. 40 CNC are from the following sources:

- Federal Programs
- State Programs
- Baltimore County
- Harford County
- Aberdeen Proving Ground
- Cities of Aberdeen
- Chesapeake Bay non-governmental organizations

To the extent possible, these programs were assessed for their location in the corridor, however, in some cases, the list may be more comprehensive, as they could be general resources for the U.S. 40 CNC.

Federal Programs

Land and Water Conservation Fund

The Land and Water Conservation Fund (LWCF) provides monies and matching grants to federal, state and local governments for the acquisition of land and water, and easements on land and water. The program is divided into two distinct funding pools: state grants and federal acquisition funds. The distribution formula takes into account population density and other factors.

Each year, based on project demands from communities as well as input from the federal land management agencies, the President makes recommendations to Congress regarding funding for specific LWCF projects. In Congress, these projects go through an Appropriations Committee review process: given the intense competition among projects, funding is generally only provided for those projects with universal support. Initially authorized for a twenty-five-year period, the LWCF has been extended for another twenty-five years, its current mandate running until January 2015.²

Impact in Maryland: Monies from the LWCF have been utilized over the years on projects both large and small. LWCF has helped state agencies and local communities acquire nearly seven

² www.nps.gov/lwcf/lwcf_04_rev.pdf;



million acres of land and easements controlling further land, and developed project sites. Maryland has received approximately \$198 million from LWCF over the past four decades.

Conservation Reserve Program (CRP)

Designed for agricultural producers with cropland or marginal pastureland, under CRP, farmers convert highly erodible cropland or other environmentally sensitive acreage to vegetative cover, to improve the quality of water, control soil erosion, and enhance wildlife habitat. Farmers receive an annual rental payment for the term of the 10-15 year contract. Cost sharing, up to 50%, is provided to establish approved conservation practices. CRP is administered by the Farm Service Agency, with Natural Resource Conservation Service (NRCS) providing technical land-eligibility determinations, conservation planning and practice implementation.³

Impact in Maryland: Maryland farms received \$10,604,947 from the Conservation Reserve Program in 2009. Farms in Harford County received \$167,783. Baltimore County farms received \$50,071.

Conservation Reserve Enhancement Program (CREP)

In 1997 through a Memorandum of Agreement with USDA, Maryland became the first state to create a partnership to augment USDA's existing CRP by jointly committing resources to establish buffers, restore wetlands and retire highly erodible agricultural lands adjacent to water bodies that drain into the Chesapeake Bay.

Impact in Maryland: USDA committed to CREP contracts on 100,000 acres of land in Maryland, and the State agreed to preserve 25,000 acres by permanent easement. Eligible landowners in CREP can receive assistance for removing land from agricultural production, installing conservation practices and executing perpetual easements through Rural Legacy, MALPF, or MET. The USDA share for Maryland CREP is estimated to be \$170 million for rental payments to be made over the next 15 years, and about \$21 million for cost-share payments during the same period, for a total of \$191 million. Farmers have also received additional bonus payments through private sources and USDA incentive payments.⁴

Wetlands Reserve Program (WRP)

WRP, administered by the USDA's NRCS, is a voluntary program offering eligible landowners the opportunity to protect their lands through permanent easements, 30-year easements, or restoration cost-share agreements. The program requires that the NRCS and the landowner create a plan for the restoration of the area under the easement. Payment rates for easements are established by the state conservationist based on the agricultural value of the land. NRCS will pay 100% of the costs to restore and maintain a wetland on land under a permanent easement,

³ <http://www.nrcs.usda.gov/programs/crp> http://www.md.nrcs.usda.gov/programs/crp_crep/crp_crep.html

⁴ Cecil County, Maryland, Green Infrastructure Plan. The Conservation Fund, Arlington, VA, 2007.
http://www.md.nrcs.usda.gov/programs/crp_crep/crp_crep.html



and 75% of the cost of restoration on lands under 30-year easements or 10-year cost-share agreements.⁵

Impact in Maryland: To be eligible for WRP in Maryland, land must be restorable and suitable for wildlife habitat. In Baltimore and Harford Counties, permanent easements are \$5930/acre for woodland and \$8170/acre for cropland; for 30 year easements, \$4448/acre for woodland and \$6128/acre for cropland. Rates are reviewed annually and determined by a market analysis. In 2010, 20 agreements were signed in Maryland covering 3,097 acres, at a cost of \$6.9 million.

Wildlife Habitat Incentives Program (WHIP)

Through WHIP, USDA's NRCS provides both technical assistance and up to 75% cost-share assistance to establish and improve fish and wildlife habitat. WHIP agreements between NRCS and the participant generally last from 5 to 10 years from the date the agreement is signed

Impact in Maryland: Maryland's identified wildlife habitat priorities and conservation practices eligible for WHIP funding in Maryland include: restoration of grassland habitat in field borders and entire fields; restoration of riparian buffers; stabilization of stream banks; restoration of wetlands; and establishment of shallow water areas for wildlife. To qualify for WHIP, the application must consist of at least one acre of eligible wildlife habitat improvement practices, or at least \$300 of WHIP cost-share assistance. Lands already enrolled in other USDA programs, such as the CRP, CREP, and WRP, are not eligible for WHIP. Funding is limited and highly competitive. In 2010, 21 contracts were completed or active in Maryland covering 157 ac, at a cost of \$134,489. ⁶

Farm and Ranch Lands Protection Program (FRPP)

Under FRPP, USDA's NRCS may enter into an agreement with an eligible entity to pay up to 50% of the appraised fair market value for a conservation easement on private land. Eligible entities include tribal, state, local and appropriate NGOs. Eligible land includes prime, unique, or other productive farm or ranch land, or land containing historical or archaeological resources where a pending offer for purchase of development rights from an eligible entity exists.⁷

Impact in Maryland: In 2010, 6 parcels in Maryland totaling 1,398 acres were enrolled, at a cost of \$4.3 million.

Environmental Quality Incentives Program (EQIP)

EQIP is a voluntary conservation program that promotes agricultural production and environmental quality as compatible national goals. Through EQIP, farmers may receive

⁵ <http://www.md.nrcs.usda.gov/programs/wrp/wrp.html>

⁶ <http://www.md.nrcs.usda.gov/programs/whip/whip.html>

⁷ www.nrcs.usda.gov/programs/frpp/, <http://www.md.nrcs.usda.gov/programs/frpp/frpp.html>



financial and technical help with structural and management conservation practices on eligible agricultural land.⁸

Impact in Maryland: In 2010, 200 contracts were signed in Maryland covering 28,769 acres, at a cost of \$6.6 million.

Forest Legacy Program (FLP)

This is a national program of USDA Forest Service that is administered in Maryland by the Department of Natural Resources (DNR). The program is designed to identify and protect environmentally important forest lands through the use of perpetual conservation easements from willing sellers.

Impact in Maryland: The program is available only in areas identified in Maryland's Forest Legacy Assessment of Need, including Harford County.⁹

Coastal and Estuarine Land Conservation Program (CELCP)

Operated through the National Oceanic and Atmospheric Administration (NOAA), CELCP was established in 2002 to protect coastal and estuarine lands considered important for their ecological, conservation, recreational, historical or aesthetic values. The program provides state and local governments with matching funds to purchase significant coastal and estuarine lands, or conservation easements on such lands, from willing sellers. Lands or conservation easements acquired with CELCP funds are protected in perpetuity. The proposed Maryland CELCP plan generally favors projects located within the boundaries of the State's Green Infrastructure Assessment maps identified in the plan.

Impact in Maryland: A state must have an approved CELCP plan in order to compete for funding, and Maryland officials have yet to complete their plan.

Forest Stewardship Program

This program provides technical assistance, through state forestry agencies, to non-industrial private forest owners to encourage and enable active long-term forest management to provide timber, wildlife habitat, watershed protection, recreational opportunities and many other benefits for landowners and society, both now and in the future.¹⁰

Impact in Maryland: The Maryland DNR Forest Service administers programs for forest land owners. Ninety percent of Maryland's forest land is owned by private woodland owners. Private landowners are encouraged to practice forest stewardship and leave the land and its resources in better condition for future generations.

⁸ <http://www.md.nrcs.usda.gov/programs/eqip/eqip.html>

⁹ www.fs.fed.us/spf/coop/programs/loa/flp.shtml

¹⁰ www.fs.fed.us/spf/coop/programs/loa/fsp.shtml



Landowner Incentive Program

This program supports projects that enhance, protect, or restore habitats that benefit "species-at-risk" on privately owned lands. This program is a competitive grant program that establishes partnerships between federal and state governments and private landowners.¹¹

Impact in Maryland: Maryland DNR administers LIP grants in the state. Priority areas include Maryland's Ecologically Significant Areas, which are geographic areas that incorporate buffered locations of state records of endangered, threatened, and sensitive species and ecologically diverse habitats.¹²

North American Wetlands Conservation Act Grants Program

This program supports the long-term protection of wetlands and associated uplands habitats needed by waterfowl and other migratory birds. Projects must support long-term wetlands acquisition, restoration, and/or enhancement.¹³

Impact in Maryland: Not counting multistate projects, between 1990 and 2005, 14 projects in Maryland, totaling 66,264 acres, were awarded \$11.8 million.

Partners for Fish and Wildlife

This program supports voluntary restoration of wetlands and other fish and wildlife habitats on private land through public-private partnerships. Projects are designed to restore native habitat to as near a natural state as possible.¹⁴

Impact in Maryland: The Partners for Fish and Wildlife program has targeted priority areas including farmed or drained wetlands, riparian habitats, native grasslands, salt marshes, and upland communities. As of 2006, over 400 projects had been completed, 300 acres of forests reestablished, and 80 miles of riparian buffers restored, among other accomplishments.

Agricultural Management Assistance

This program provides cost share assistance to agricultural producers to voluntarily address issues such as water management, water quality, and erosion control by incorporating conservation into their farming operations. Producers may construct or improve water management structures or irrigation structures; plant trees for windbreaks or to improve water quality; and mitigate risk through production diversification or resource conservation practices, including soil erosion control, integrated pest management, or transition to organic farming.¹⁵

¹¹ <http://federalaid.fws.gov/lip/lipguidelines.html>

¹² <http://www.dnr.state.md.us/wildlife/Habitat/LIP/index.asp>

¹³ <http://www.fws.gov/birdhabitat/Grants/NAWCA/index.shtm>

¹⁴ <http://www.fws.gov/partners/HowToPartner/altcont.html>

¹⁵ <http://www.nrcs.usda.gov/programs/ama/>



Impact in Maryland: In 2010, 61 projects in Maryland, totaling 386 acres, were awarded \$413,354.

Conservation Innovation Grants

This is a voluntary program to stimulate the development and adoption of innovative conservation approaches and technologies to address natural resource concerns. It leverages federal investment in environmental enhancement and protection, in conjunction with agricultural production.¹⁶

Impact in Maryland: In 2010, the MD Department of Agriculture, University of Maryland Eastern Shore, and Chester River Association received \$1.6 million for projects. In 2011, the Chesapeake Bay Foundation received \$455,000 to estimate N₂O reductions from nutrient management in the Chesapeake Bay watershed.

State Programs

Program Open Space

Program Open Space (POS) funds are designed to offset development trends by conserving open space and building recreational infrastructure. Funded through a 0.5% real estate transfer tax, POS revenues now support additional conservation programs including the protection of threatened and endangered species habitat (through the Heritage Conservation Fund); agricultural land preservation (through the Maryland Agricultural and Land Preservation Foundation – MALPF); historic preservation (through the Maryland Heritage Areas Authority); and protection (acquisition) of large blocks of land with significant farm, forest, historic and natural resources (through the Rural Legacy Program).

POS provides up to 100% of a project's cost for the acquisition of open space areas throughout the state and up to 90% for development of local outdoor recreation areas. Half of POS funds are allocated for State acquisitions and half is allocated to local governments for acquisition and development of land for recreation and open space purposes. Each county must use at least half of its allocation for land acquisitions. A county may use the remaining half of its allocation for land acquisition or development projects, and 20% of the funds may be used for capital renewal but not routine maintenance.

Stateside POS funds are allocated to purchase land for state parks, forests, wildlife habitat, or natural, scenic and cultural resources for public use. A portion of stateside funds are also dedicated to capital improvements, critical maintenance, and state park operations. Stateside POS projects are being driven by a Targeting System, which uses the best scientific information available to target the program's limited funds. This includes ecological and other criteria.

The Local side of POS makes funds available to local government to help them buy land and build park facilities that will help them meet their specific goals of Land Conservation and

¹⁶ www.nrcs.usda.gov/programs/cig/



Recreation for their citizens. To date over 5,000 local grants projects have either acquired land or built facilities for Maryland's conservation and recreation needs.

Maryland's Rural Legacy (RLP)

RLP is a DNR program created to preserve large blocks of working rural lands for future generations. The Program protects natural, cultural, agricultural, forest and environmental resources from development and promotes land conservation statewide by granting funds to local governments and land trusts to conserve land through easement and fee purchases within designated rural legacy areas. The RLP uses an objective scoring approach similar to the POS Targeting to review and allocate its limited grant funds.

The Baltimore County Coastal Rural Legacy Area contains 14,711 acres. Since the RLA has been created, a contiguous block of over 1,500 protected acres has been created on the Back River Neck peninsula. There are significant opportunities for increasing public access to the Chesapeake Bay and to protect shorelines. The Harford County RLA, Deer Creek, lies outside the CNC boundaries.¹⁷

The Maryland Environmental Trust (MET)

Four main programs come under the Trust: Conservation Easements, Keep Maryland Beautiful, Local Land Trust Assistance, and Rural Historic Village Protection. MET primarily solicits and manages private landowner donated conservation easements.¹⁸

Maryland Agricultural Land Preservation Foundation (MALPF)

The Foundation purchases agricultural preservation easements that forever restrict development on prime farmland and woodland. MALPF settled on its first purchased easement in October 1980. By the end of the 2010 fiscal year, MALPF will have helped landowners permanently protect from development more than 280,000 acres on approximately 2,100 farms. <http://www.malpf.info/>

Maryland Historical Trust (MHT)

MHT operates a network of programs that work together to acquire, rehabilitate or restore historic properties and structures. Eligibility requirements vary according to established programmatic criteria. In general, owners of properties listed on or eligible for the National Register of Historic Places, or located within a locally certified or Register-listed historic district, may be eligible to obtain assistance in the form of grants, tax credits, loans and technical assistance. <http://mht.maryland.gov/>

¹⁷ http://www.dnr.state.md.us/land/rurallegacy/pdfs/BA_Costrla.pdf

¹⁸ <http://www.dnr.state.md.us/land/landconservation.asp>



Forest Conservation Act (FCA)

The main purpose of the Maryland FCA is to minimize the loss of Maryland's forest resources during land development by making the identification and protection of forests and other sensitive areas an integral part of the site planning process. Of primary interest are areas adjacent to streams or wetlands, those on steep or erodible soils or those within or adjacent to large contiguous blocks of forest or wildlife corridors.

Although the Maryland DNR Forest Service administers the FCA, it is implemented on a local level. Gaining approval of the required Forest Conservation Plan (development of more than one acre) may require long term protection of included priority areas or planting/replanting (afforestation or reforestation) a sensitive area off-site.¹⁹

Forest Stewardship Programs

The Maryland DNR Forest Service offers a variety of Forest Stewardship programs that offer technical and financial assistance. These programs cover establishment, protection, planning and management of forests. Programs include Forest Stewardship Planning, cost-share assistance, management plans, income-tax modification programs, and other resources. The University of Maryland Cooperative Extension provides research-based forest outreach and educational programs through extension offices found in each county and at regional research & education centers.²⁰

Forest Conservation and Management Program (FCMP)

The Maryland FCMP encourages landowners to manage their forest land in return for a reduced and/or frozen property tax assessment. The program is a legal agreement between the landowner and the DNR. The landowner agrees to manage their forest land according to a management plan that is prepared for the property. The property tax assessment on the forest land in the agreement is generally reduced and frozen at a low agricultural rate.²¹

¹⁹ <http://www.dnr.state.md.us/forests/programapps/newFCA.asp>

²⁰ <http://www.dnr.state.md.us/forests/programapps/stewcon.asp>

²¹ <http://www.dnr.state.md.us/forests/programapps/fcmp.html>



Baltimore County Programs

Forest Sustainability Program

The purpose of this program is to strive for healthy forests by linking communities to the Montreal Process Criteria and Indicators (MPCI), an international program to measure the ecological and economic sustainability of forest resources. The goal is to create forests that provide critical ecosystem services, quality habitat for wildlife, and provide for varied human uses, including recreation, wood products, and non-timber products. Working with the USDA Forest Service and other partners of the national Roundtable on Sustainable Forests, Baltimore County is a national pilot for application of the MPCI. Program Implementation includes:

Urban Greening, Planting Trees, and Reforestation

Baltimore County Environmental Protection and Sustainability Agency (EPS) administers several programs to encourage citizens and community organizations to plant trees to enhance environmental quality and community quality of life as part of the Forest Sustainability Program.

Growing Home Campaign – EPS provides homeowner education and incentives for planting trees in private yards.

Tree-Mendous Maryland Program – Each spring and fall, EPS promotes Tree-Mendous Maryland, a Maryland Department of Natural Resources program that provides low-cost trees to organizations for planting on public lands and community open spaces. (<http://www.baltimorecountymd.gov/Agencies/environment/workgroup>)

Rural Reforestation Program

The ecological and economic sustainability of the forest resources of Baltimore County depends to a large degree on the stewardship ethic of private landowners, who own and manage 75 percent of the forests in the County. The following are current and completed rural reforestation projects:

Rural Residential Stewardship Initiative - EPS received a grant, funded by the US EPA and administered by the National Fish and Wildlife Foundation, to develop and pilot a project to educate smaller-lot (3-6 acres or so) rural residential landowners about their role as "managers" of common forest and stream systems and to increase forest area along streams and adjacent to existing forests.

Community Reforestation Program - Development projects in Baltimore County must comply with the Forest Conservation Act, enacted by the County Council in 1992 as required by the Maryland Forest Conservation Act of 1991. For some projects, developers are permitted to pay a fee in-lieu of mitigation for required reforestation.

Land Preservation Program

This program supports a viable agricultural community, retention of forest and habitat for wildlife, and the protection of water quality for local streams, rivers and the Bay. Created in 1994 to preserve working family farms, this Baltimore County program has used innovative and



collaborative funding mechanisms for land preservation. To participate, a farm must be 50 acres in size or located adjacent to a preserved property.

Watershed Restoration Program

The watershed restoration program goal is to protect, enhance and restore the water resources of Baltimore County. Project funding is supported primarily by County General Obligation Bonds and supplemented by State funds from the Maryland Departments of the Environment and Natural Resources through the Storm Water Pollution Control, Small Creeks and Estuaries, and Waterway Improvement cost-share programs. The program includes the following types of restoration projects:

Stream Restoration - Stream restoration projects restore and stabilize highly degraded urban stream channels and enhance riparian ecosystems.

Stormwater Retrofits - Stormwater retrofit projects involve the installation of new stormwater best management practices (BMPs) facilities in communities developed prior to stormwater management requirements.

Shoreline Stabilization - Shoreline enhancement projects restore eroded shorelines and enhance tidal ecosystems and habitat.

Sustainability Network

EPS is helping Baltimore County to create a community-wide strategy through the County's own Sustainability Network (SN). The SN is an advisory committee of citizens, private sector, and County representatives, specifically tasked to help develop recommendations for a sustainability strategy for Baltimore County. (For more information and to see their recommendations:

baltimorecountymd.gov/Agencies/environment/sustainability/sustainabilitynetwork.html

Harford County Programs

Agriculture Preservation Program

Harford County's agricultural land preservation program offers voluntary programs to landowners of productive farm land to preserve productive agricultural farmland for future generations through the use of conservation easements and Agricultural Preservation Districts.

Agricultural Land Preservation Easements are part of a Purchase of Development Rights (PDR) program that, permanently retires all development potential of a particular property and maintains it for agricultural production. For participation in the easement program, the landowner receives a 100% County property tax credit with a \$50 per acre cap.

Participation in a **Harford County Land Preservation District (HALPP)** is an option for landowners to establish prior to selling their development rights. An agricultural preservation district requires a minimum five-year commitment by the landowner not to develop their land. This district can be established through the Maryland Agricultural Land Preservation Program, if the land qualifies, or through the HALPP. If a landowner established an agricultural



preservation district, their property then qualifies for up to a 50% tax credit from County Real Property Taxes. This credit is, however, limited to no more than seven years.

Priority Preservation Area Element Plan (2009)

The County adopted a Priority Preservation Plan which designated the Deer Creek Rural Legacy Area and the majority of the upper Deer Creek watershed as the Priority Preservation Area. The policies associated with the plan include an implementation strategy focused on the preservation of 80% of the remaining land in the priority area as well as preserve the function and economic viability of the agricultural land.

Purchase of Development Rights (PDR) Program: In 2006, the County updated its PDR Program to enable the Harford County Agricultural Land Preservation Advisory Board to adjust the County's per-acre value on an annual basis and ensure that offers remained competitive with the real estate market. The ranking system was also adjusted to add points for properties located within or adjacent to designated Priority Preservation Areas and Rural Legacy Areas. (<http://www.harfordcountymd.gov/PlanningZoning/index.cfm?ID=7>)

Transfer of Development (TDR) Right Program: The intent of the Harford TDR program is to facilitate development flexibility thereby limiting sprawl development while protecting farmlands for long-term agricultural use. The TDR program gives the property owner the option to sell development rights rather than subdivide lots. As result, the TDR program offers the farmer a new option to continue farming while facilitating development in other areas. (<http://www.harfordcountymd.gov/PlanningZoning/index.cfm?ID=179>)

Water Source Protection District

The purpose of establishing these districts is to provide a safe drinking water supply and to maintain public health, safety and quality of life. Regulations were established in the Perryman wellfield district, community water system districts and nontransient-noncommunity water system districts. Uses that are considered to pose a high risk to groundwater and surface water are prohibited in these areas and impervious surface limitations may apply in some districts. The Perryman wellfield abuts the Aberdeen Proving Ground and is within the U.S. 40 CNC boundary. (<http://www.harfordcountymd.gov/PlanningZoning/index.cfm?ID=212>)

Natural Resource District: Harford County protects many of its sensitive environmental features through the Natural Resources District (NRD) subsection of the Zoning Code. In general, NRD helps protect the ecology of an area by minimizing soil disturbance and loss of natural ground cover. Generally, mass cutting, clearing, grading or removal of vegetation is not allowed. (<http://www.harfordcountymd.gov/PlanningZoning/index.cfm?ID=210>)

Forest and Tree Conservation Provisions

The intent of this 1991 law is three-fold. First, it requires that the natural features within a proposed development site be identified and delineated by an approved professional forester or landscape architect before a development plan for the site is submitted to the County. Second, it requires that a portion of the existing forest resources on-site be retained. Finally, it requires that a measure of the forest resources which are lost due to the development process be replaced. The County then created a "Forest Cover Conservation and Replacement Manual" which



integrates the requirements of the 1991 Law into the County's development review process. The Manual contains information which is used in the preparation of Forest Stand Delineations and Forest Conservation Plans. It also provides guidance on reforestation, afforestation and individual tree landscaping. (Harford County 2009 Natural Resources Element Plan: <http://www.harfordcountymd.gov/PlanningZoning/Download/1117.pdf>)

The Chesapeake Bay Critical Area (CBCA) Management Program and the Chesapeake Bay Critical Area Overlay District

The CBCA Management Program and the CBCA Overlay District are administered by the Department of Planning and Zoning as part of a coordinated State effort to improve water quality and wildlife habitat throughout the Chesapeake Bay. The program manages lands within 1,000 feet of tidal waters and also includes some additional floodplain, park, and rare species habitat areas.

The Chesapeake Bay National Estuarine Research Reserve (CBNERR)

Located less than one-mile from U.S. 40 is Otter Point Creek, part of the Chesapeake Bay National Estuarine Research Reserve system. The CBNERR system was established to protect estuarine areas as natural field laboratories for long-term research and monitoring. CBNERR provides opportunities for education in addition to promoting public awareness, understanding, and appreciation of estuarine ecosystems. Otter Point Creek is managed by CBNERR, Harford County Department of Parks and Recreation, and the Izaak Walton League of America. The Otter Point Creek component, totaling 672 acres, consists of two land areas connected by water. It includes Leight Park (61 acres), Bosley Conservancy (350 acres), and State-owned water (261 acres). (<http://www.dnr.state.md.us/bay/cbnerr/>)

Aberdeen Proving Ground Programs

Aberdeen Proving Ground provides large areas of natural habitat for many species. The post is composed of roughly 50% hardwood forest, 34% mowed/grassy areas, 13% marsh or marsh shrub, 2% bare earth, and 1% shrub habitat. The Environmental Conservation and Restoration Division manages a variety of environmental programs designed to protect human health and the environment.

(<http://www.apg.army.mil/apghome/sites/directorates/dpw/environment/ecsd.cfm>)

Environmental Restoration/Cleanup Program

The Environmental Restoration/Cleanup Program, manages the investigation and remediation of hazardous waste sites caused by historical disposal activities at the installation. The fundamental goal of the APG restoration program is to protect human health, safety and the environment. The Army accomplishes this by eliminating or reducing to prescribed, safe levels any potential risks caused by the Army's past operations.

Range Sustainability and Ordnance Program

APG has more than 103 miles of shoreline which represents 90% of Harford County's shoreline. Shoreline erosion occurs at a significant rate in some areas thus impacting buildings, roads,



testing ranges, and test facilities. Erosion also causes nutrient loading which can affect the water quality in the Chesapeake Bay. The environmental program at APG has taken a number of actions to stabilize shorelines and remove hazardous materials which have become exposed.

Noise Program

The noise program ensures APG's noise policies are maintained throughout the installation and conducts oversight of tenant activities. The noise program coordinates with the NEPA program to review proposed new programs which may have the potential for increased noise levels.

In addition to the programs under the Environmental Conservation and Restoration Division, APG is committed to Urban Forestry as part of environmental stewardship. Preserving APG's wildlife and trees is part of the 2009 Army Chesapeake Bay Strategy. The Army Chesapeake Bay Strategy Goals are: contribute to restoring and sustaining the water quality of the Chesapeake Bay and its tributaries; restore and sustain living resources and healthy habitats on Army installations; support the implementation of ecosystem-based fisheries management; strengthen storm water management practices; and maintain healthy watersheds and foster Chesapeake Bay stewardship. <http://aec.army.mil>.

City of Aberdeen

Comprehensive Plan: Sensitive Areas

Aberdeen's Comprehensive Plan addresses (1) streams and their buffers; (2) the 100-year floodplain; (3) habitats of threatened and endangered species; and (4) steep slopes as required by the State of Maryland's Growth Act. In addition, the Comprehensive Plan describes the City of Aberdeen's approach to protecting eight distinct types of Sensitive Areas, defining each and justifying the level of protection for each: (1) streams and their buffers; (2) 100-year floodplains; (3) habitats for threatened and endangered species; (4) steep slopes; (5) forests; (6) hydrogeology; (7) critical areas; and (8) historical sites. (<http://www.aberdeen-md.org/storage/comp-plan/Chapter%208.pdf>)

Chesapeake Bay Non-Governmental Organizations

Chesapeake Bay Foundation

The Chesapeake Bay Foundation (CBF) is a non-profit organization that advocates for creative solutions to pollution reduction in the Chesapeake Bay and its tributaries. The CBF has several restoration and education programs that bring together federal, state, and local agencies, as well as local citizens to participate in projects that take positive action toward restoring the Bay. (<http://www.cbf.org/>)

Chesapeake Bay Trust

The Chesapeake Bay Trust (CBT) is a nonprofit, grant-making organization dedicated to on-the-ground change for the restoration and enhancement of the Chesapeake Bay and its tributaries in Maryland. Their goal is to increase stewardship through grant programs, special initiatives, and



partnerships that support environmental education, demonstration-based restoration, and community engagement activities. (<http://www.cbtrust.org>)

Alliance for the Chesapeake Bay

The Alliance for the Chesapeake Bay is a non-profit organization that works to engage the Chesapeake Bay community to develop solutions to improve, preserve, and protect the Bay and its resources. The Alliance provides several programs focused on restoration and conservation of resources in and beyond the Chesapeake Bay watershed. (www.allianceforthebay.org/)

Chesapeake Bay Funders Network

The Chesapeake Bay Funders Network is a collaboration of regional non-profit foundations that facilitates opportunities to protect the Chesapeake Bay through programs that pool resources to implement projects. (<http://www.chesbayfunders.org>)

M.3 CONSERVATION BEST PRACTICES

The following recommended new best practices are summarized for consideration within the U.S. 40 CNC. These include a range of best practices including financing methods, analyses, expansion or refinement of existing programs, strengthened support for land trusts, planning and zoning, management practices, and environmental improvements and enhancements. This list includes important strategies and tools not currently used in the corridor or recommended for adoption across the corridor to help achieve the emission reduction goals laid out in the CNC strategy.

Urban trees

Trees in urban areas help avoid emissions from power production, and from the operation and maintenance of built structures and infrastructure. Further, urban trees contribute to lower summertime temperatures at street level. Reduced heat slows the formation of ground-level ozone, as well as the evaporation and volatilization of organic compounds from vehicles. Trees also take in CO₂ for photosynthesis, storing carbon in their biomass through growth. Trees likewise reduce ambient concentrations of volatile organic compounds, nitrous oxide (N₂O), fine particulate matter, and other air and water pollutants.

Implementation Mechanisms:

- Insert urban tree planting strategy and objectives in all comprehensive plans.
- Encourage local counties to identify, maintain, and augment street tree populations.
- Provide outreach and education on the significance of trees and their role in our built environment.
- Monitor and report plantings at the local level.
- Provide enhanced funding from conservation programs like Program Open Space (POS) to local jurisdictions to implement policies (e.g., wood recovery and canopy goals) and to plant trees.



Related Policies/Programs in Place:

- Urban Community Forestry Act.
- Tree-mendous Maryland, a program that, for a fee, individuals can request a tree be planted as a memorial.
- Chesapeake Bay Program's Forest Conservation Directive 2020 goals. The Governor of Maryland committed to establishing urban canopy goals by 2020 for 50% of the area developed before storm-water management regulations (i.e., pre-1984), among other goals.
- Community Woodlands Alliance, a group of local artisans building furniture from old-growth urban trees.

Reforestation

Increasing forest and tree cover provides additional benefits for mitigation of GHGs in addition to sequestration. This policy option promotes forest cover and associated carbon stocks by regenerating or establishing healthy, functional forests through afforestation (on lands that have not, in recent history, been forested, including agricultural lands) and reforestation (on lands with little or no present forest cover) where current beneficial practices are not displaced. Successful establishment requires commitment for as long as 20 years. This policy promotes the implementation of practices, such as soil preparation, erosion control, and supplemental planting to ensure conditions that support forest growth. Natural forest in this area is primarily oak-hickory, which sequesters carbon at significantly higher rates than oak-pine or pine forest.

Numerous groups are involved in tree planting events and programs throughout Baltimore and Harford Counties. Some examples include:

- Baltimore Gas & Electric Company's tree plantings at schools, parks, and trails;
- Vulcan Materials' partnership with MDE to help in restoration of the American chestnut at their Havre de Grace Quarry in Harford County. In addition to the American Chestnuts, Vulcan has planted over 6,000 trees in the last two years in Havre de Grace.
- The Maryland National Guard's annual tree planting at the Havre de Grace Military Reservation in partnership with the Maryland Department of Natural Resources.
- Harford and Baltimore Counties participation in the Growing Home program, an innovative public-private partnership between Baltimore County, Baltimore City, Harford County, nearly 50 local retail nurseries and garden centers and homeowners. The program is intended to increase the overall tree canopy on private property in the Baltimore area.
- The Maryland DNR - Forest Service's *Backyard Buffers* Program launched this spring in Harford County. The program provides a free "buffer in a bag" to help get homeowners started in buffering their streamside. The bag includes twenty-five native tree and shrub bare-root seedlings of various species that are well suited to streamside conditions.
- The Tree-Mendous Maryland Program, that coordinates the free delivery of trees to citizens and community groups in Baltimore County for use in parks, school grounds, municipal streets, government facilities, and homeowners associations' open spaces. (<http://www.dnr.state.md.us/forests/treemendous/>)



- The University of Baltimore's participation with the Chesapeake Bay Foundation's ongoing volunteer effort to plant trees throughout the Bay watershed—an extended effort to slow down runoff and mitigate soil erosion into the Bay.

Other Implementation Mechanisms:

- Allowances from Regional Greenhouse Gas Initiative (RGGI) auctions could be made available for reforestation and restoration.
- Ask utility companies to offset acres of forest lost to clearing for utility corridors.
- The Maryland Department of Transportation, under offset requirements, must reforest an amount of acreage equal to that developed for major highways.
- Implement a more comprehensive corridor-wide tree-planting program to achieve carbon reductions.

Forest and Wetland Protection and Mitigation

To ensure wetland buffers will be available for Maryland, current wetlands need to be able to move inland as the sea level rises. Without inland areas to which these wetlands can migrate, the Chesapeake Bay's coastal wetlands could simply be drowned by rising Bay waters. Acquisition of lands adjacent to existing tidal marsh or by conservation easements is essential for wetlands to migrate landward as sea level rises.

Wetlands with long periods of inundation or surface saturation during the growing season are especially effective at storing carbon in the form of peat, though there are uncertainties associated with carbon storage in wetlands. In many cases, wetlands are a natural sink for carbon, but can also be a source of CH₄ when decomposition occurs after extended highly anaerobic conditions. Other wetlands, such as saltwater marshes, are different; they support carbon sequestration, but emit negligible amounts of CH₄ because sulfate in saline water suppresses the development of CH₄-generating organisms. Conterminous U.S. tidal marshes accumulate on average 2.2 million grams of carbon per hectare per year. Because they accumulate sediment and bury organic matter, floodplain and tidal wetlands are especially effective as carbon sinks. These lands also reduce nutrient, sediment, and other pollution into the Chesapeake Bay and other water bodies.

Maryland state law requires that all forests within the Critical Area that are cleared be replaced on no less than an equal area basis. In addition to mitigation requirements for clearing, developers must plant new trees in the Critical Area where forest is lacking.

Some Implementation Mechanisms:

- Maryland Tidal Wetlands Act, and non-tidal wetlands regulatory programs and associated no-net loss of wetlands goals.
- MDE-Shoreline Erosion Control Guidelines: Marsh Creation.
<http://www.mde.state.md.us/assets/document/wetlandswaterways/Shoreerosion.pdf>
- MDE-Water Quality Infrastructure Program, which manages federal and state grants, some of which are directed at small creeks and estuaries restoration.
http://www.mde.state.md.us/Programs/WaterPrograms/WQIP/wqip_smallcreeks.asp



- MDE-Wetlands and Waterways Program (with targeting documents for prioritizing wetlands for restoration, preservation, and mitigation)
http://www.mde.state.md.us/Programs/WaterPrograms/Wetlands_Waterways/about_wetlands/prioritizingareas.asp
- Allowances from RGGI auctions should be available for restoration.
- Use water control structures equipped with flashboard risers and tide gates to restore the hydrology of ditched wetlands and prevent saltwater intrusion into freshwater wetlands.
- Plant wetland vegetation. Where needed, replenish sediment and plant marsh grass.
- DNR identifies wetland vulnerability and future migration potential using the Sea Level Affecting Marshes Model (SLAMM).



M.4 ADDITIONAL RESOURCES

1. Aberdeen Proving Grounds Environmental Conservation and Restoration Branch, www.apg.army.mil/apghome/sites/directorates/dpw/environment/ecsd.cfm
2. Alliance for the Chesapeake Bay, www.allianceforthebay.org/
3. Baltimore County Facts about Land Preservation, www.baltimorecountymd.gov/Agencies/environment/landpreservation/index.html
4. Baltimore County Forest Sustainability Program, www.baltimorecountymd.gov/Agencies/environment/workgroup
5. Baltimore County Living Shorelines, www.baltimorecountymd.gov/Agencies/environment/watershedrestoration/shoreline.html
6. Baltimore County Sustainability Network, www.baltimorecountymd.gov/Agencies/environment/sustainability/sustainabilitynetwork.html
7. Baltimore County Watershed Management Program, <http://www.baltimorecountymd.gov/Agencies/environment/watersheds/index.html>
8. Chesapeake Bay Foundation, <http://www.cbf.org/>
9. Chesapeake Bay Funders Network, <http://www.chesbayfunders.org>
10. Chesapeake Bay Program, <http://www.chesapeakebay.net/>
11. Chesapeake Bay Trust, <http://www.cbtrust.org>
12. City of Aberdeen Comprehensive Plan, <http://www.aberdeen-md.org/storage/comp-plan/Chapter%208.pdf>
13. Common Waters Fund, <http://www.commonwatersfund.org/welcome>
14. Gunpowder Valley Conservancy, <http://www.gunpowderfalls.org/>
15. Harford Community College, Green Harford initiative, <http://www.harford.edu/GreenHCC/default.asp>
16. Harford County Agricultural Preservation, <http://www.harfordcountymd.gov/PlanningZoning/index.cfm?ID=7>
17. Harford County Floodplain Management Program, <http://www.harfordcountymd.gov/PlanningZoning/index.cfm?ID=198>
18. Harford County Priority Preservation Area Element Plan, 2009, <http://www.harfordcountymd.gov/PlanningZoning/Download/1018.pdf>
19. Harford County Transfer of Development Rights, <http://www.harfordcountymd.gov/PlanningZoning/index.cfm?ID=179>
20. Harford County, Natural Resource District, <http://www.harfordcountymd.gov/PlanningZoning/index.cfm?ID=210>



21. Harford County, Water Source Protection District,
<http://www.harfordcountymd.gov/PlanningZoning/index.cfm?ID=212>
22. Harford Land Trust, <http://www.harfordlandtrust.org/>
23. Johns Hopkins University Office of Sustainability <http://www.sustainability.jhu.edu/>
24. Land and Water Conservation Fund, Project List by County,
<http://www.noia.org/website/download.asp?id=1823>
25. Maryland Agricultural Land Preservation Foundation, <http://www.malpf.info/>
26. Maryland Climate Change Commission's *Climate Action Plan*, 2008.
<http://www.mdclimatechange.us/>
27. Maryland Department of Natural Resources Rural Legacy Program,
28. http://www.dnr.state.md.us/land/rurallegacy/pdfs/BA_Coastrla.pdf
29. Maryland Department of Natural Resources, Forest Conservation Act,
30. <http://www.dnr.state.md.us/forests/programapps/newFCA.asp>
31. Maryland Department of Natural Resources, Forest Service, multiple program pages,
32. <http://www.dnr.state.md.us/forests/>
33. Maryland Department of Natural Resources, Land Conservation,
34. <http://www.dnr.state.md.us/land/landconservation.asp>
35. Maryland Department of Natural Resources, Landowner Incentive Program,
36. <http://www.dnr.state.md.us/wildlife/Habitat/LIP/index.asp>
37. Maryland Department of the Environment–Shoreline Erosion Control Guidelines: Marsh
38. Creation, www.mde.state.md.us/assets/document/wetlandswaterways/Shoreerosion.pdf
39. Maryland Department of the Environment–Water Quality Infrastructure Program,
http://www.mde.state.md.us/Programs/WaterPrograms/WQIP/wqip_smallcreeks.asp
40. Maryland Department of the Environment–Wetlands and Waterways Program,
http://www.mde.state.md.us/Programs/WaterPrograms/Wetlands_Waterways/about_wetlands/prioritizingareas.asp
41. Maryland GreenPrint, <http://www.greenprint.maryland.gov/>
42. Maryland Heritage Trust, <http://mht.maryland.gov/>
43. Neighborspace of Baltimore County, Inc., <http://www.neighborspacebaltimorecounty.org/>
44. The Conservation Fund, Baltimore County Land Preservation Model,
http://conservationfund.org/project/baltimore_county
45. U.S. Army Environmental Command, <http://aec.army.mil>